



Annex B2.4: Aquatic Ecology Assessment Report

Standard Gate two submission for London
Water Recycling SRO

Notice – Position Statement

This document has been produced as the part of the process set out by RAPID for the development of the Strategic Resource Options (SROs). This is a regulatory gated process allowing there to be control and appropriate scrutiny on the activities that are undertaken by the water companies to investigate and develop efficient solutions on behalf of customers to meet future drought resilience challenges.

This report forms part of suite of documents that make up the 'Gate 2 submission.' That submission details all the work undertaken by Thames Water in the ongoing development of the proposed SRO. The intention at this stage is to provide RAPID with an update on the concept design, feasibility, cost estimates and programme for the schemes, allowing decisions to be made on their progress.

Should a scheme be selected and confirmed in the Thames Water final Water Resources Management Plan (WRMP), in most cases it would need to enter a separate process to gain permission to build and run the final solution. That could be through either the Town and Country Planning Act 1990 or the Planning Act 2008 development consent order process. Both options require the designs to be fully appraised and, in most cases, an environmental statement to be produced. Where required that statement sets out the likely environmental impacts and what mitigation is required.

Community and stakeholder engagement is crucial to the development of the SROs. Some high-level activity has been undertaken to date. Much more detailed community engagement and formal consultation is required on all the schemes at the appropriate point. Before applying for permission Thames Water will need to demonstrate that they have presented information about the proposals to the community, gathered feedback and considered the views of stakeholders. We will have regard to that feedback and, where possible, make changes to the designs as a result.

The SROs are at a very early stage of development, despite some options having been considered for several years. The details set out in the Gate 2 documents are still at a formative stage.

Disclaimer

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LONDON EFFLUENT REUSE SRO

B.2.4 Aquatic Ecology Assessment Report

Report for: Thames Water Utilities Ltd

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1. INTRODUCTION

This report is part of series of Environmental Assessment Reports which catalogue the set of environmental assessments of the London Effluent Reuse Strategic Resource Option (SRO) through RAPID Gate 2: *Detailed feasibility, concept design and multi-solution decision making* and onward to RAPID Gate 3: *Developed design, finalised feasibility, pre-planning investigations and planning applications*. The reports set out the environmental assessments, which will in turn support regulatory assessment requirements proportionate to RAPID Gate 2 and onward to RAPID Gate 3. The scope and approach to the environmental evidence provided in these reports was set out in the Gate 2 Scoping Report and consulted on with the National Appraisal Unit (NAU) in November 2021.

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This report forms part of suite of documents that make up the 'Gate 2 submission'. That submission details all the work undertaken by Thames Water (TWUL) in the ongoing development of the proposed SRO. The intention at this stage is to provide RAPID with an update on the concept design, feasibility, cost estimates and programme for the schemes, allowing decisions to be made on their progress.

Should a scheme be selected and confirmed in the TWUL final Water Resources Management Plan (WRMP), in most cases it would need to enter a separate process to gain permission to build and run the final solution. That could be through either the Town and Country Planning Act 1990 or the Planning Act 2008 development consent order process. Both options require the designs to be fully appraised and, in most cases, an environmental statement to be produced. Where required that statement sets out the likely environmental impacts and what mitigation is required.

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1.1 LONDON EFFLUENT REUSE STRATEGIC RESOURCE OPTIONS

For Gate 2, the London Effluent Reuse SRO is set out as four source options and a range of sizes. One option is in east London, utilising final effluent from Beckton sewage treatment works (STW). The other three options are in west London, utilising crude sewage or final effluent from Mogden STW to a maximum total reduction of 200 Ml/d, with differing London Effluent Reuse scheme discharge locations in the freshwater River Thames.

Full details of the conceptual design of the four schemes are provided in the Annex A Conceptual Design Reports¹ (CDR). For assessment purposes no specific mitigation is allowed for unless included as part of option design as set out in CDR (other than the Annex B.3. Habitats Regulations Assessment (HRA) Stage 2 and Annex B.5. Initial Environmental Appraisal (IEA)) which has regard for additional mitigation as per the ACWG methodology). A DRA intake would include appropriate fish screening and all new outfalls would include appropriate European eel management measures.

High level summaries of each option are provided below. A full summary for the indicative operating pattern of a London Effluent Reuse SRO is presented in Section 1.2 of the Annex B.2.1. Physical Environment Assessment Report².

¹ Jacobs (2022) London Reuse Strategic Resource Option, Gate 2 Conceptual Design Reports.

² Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Physical Environment Assessment Report.

1.1.1 Beckton water recycling Scheme

Final effluent from Beckton STW would be treated at a new advanced water recycling plant (AWRP) within Beckton STW for advanced treatment. Recycled water would be conveyed via a new tunnel from the Beckton AWRP to Lockwood Pumping Station and then a TLT extension from Lockwood Pumping Station to a proposed new outfall located on a side channel of the freshwater Lee Diversion Channel, known as the Enfield Island Loop, upstream of the existing Thames Water Enfield intake to the King George V Reservoir. Additional abstraction for public water supply on a put/take basis would be through existing intakes in the lower River Lee, to supplement the raw water supply to the Lee Valley reservoirs. The option reduces the final effluent at the extant Beckton STW outfall to the estuarine Thames Tideway.

The Beckton water recycling scheme has been assessed for Gate 2 independently at 100 MI/d, 200 MI/d, and 300 MI/d.

1.1.2 Mogden water recycling Scheme

Final effluent from Mogden STW would be pumped in a new pipeline to a new AWRP located at a site near Kempton water treatment works (WTW) for advanced treatment. Recycled water would be transferred in a new pipeline for discharge into the freshwater River Thames at a new outfall upstream of the existing Thames Water Walton intake. Additional abstraction for public water supply on a put-take basis would be through existing downstream intakes on the River Thames. AWRP wastewater and reverse osmosis (RO) concentrate would be conveyed back to Mogden STW inlet works via a return pipeline(s). There is an option that the AWRP wastewater could be discharged to the South Sewer for return to Mogden STW, but it is not possible to return the RO concentrate by this means. The scheme reduces the final effluent at the extant Mogden STW outfall to the estuarine Thames Tideway.

The Mogden water recycling scheme has been assessed for Gate 2 independently at 50 MI/d, 100 MI/d, 150 MI/d and 200 MI/d.

1.1.3 Mogden South Sewer Scheme

Crude sewage would be diverted from the South Sewer of the sewerage catchment of Mogden STW. The South Sewer runs close to Kempton Park WTW, and the diverted sewage would be pumped to a new AWRP located at a site near Kempton WTW for advanced treatment. Recycled water would be transferred in a new pipeline for discharge into the freshwater River Thames at an outfall upstream of the existing Thames Water Walton intake. Additional abstraction for public water supply on a put-take basis would be through existing downstream intakes on the freshwater River Thames. Waste streams from the AWRP would be conveyed by a new pipeline and treated at Mogden STW. The scheme reduces the final effluent at the extant Mogden STW outfall to the estuarine Thames Tideway.

The Mogden South Sewer scheme has been assessed for Gate 2 at 50 MI/d.

During Gate 2, Thames Water took the decision to pause development of the Mogden South Sewer scheme due to limitations on available flow within the sewer, cost of the scheme and regional modelling not selecting the scheme under any water resources planning horizon scenario. The Gate 1 concept design is therefore used in Gate 2, with the exception where scheme elements are shared with the Mogden water recycling scheme (certain conveyance routes, AWRP and discharge location) which have been further developed through Gate 2.

The Mogden South Sewer scheme has not been progressed through Gate 2 environmental assessments, and so a dedicated assessment section is not included within this report. However, due to the similarities with the 50 MI/d Mogden water recycling scheme (AWRP, discharge location and volume), the outcomes of that assessment can be considered representative of an aquatic ecology assessment of a 50 MI/d Mogden South Sewer scheme.

1.1.4 Teddington DRA Scheme

Final effluent from Mogden STW would be subject to further treatment at a new tertiary treatment plant (TTP) at Mogden STW. The treated water would be transferred in a new pipe-jacked tunnel for discharge into the freshwater River Thames at a new outfall upstream of the tidal limit at Teddington Weir. Additional abstraction for public water supply on a take-put basis would be through a new intake from the freshwater River Thames, upstream of the new outfall. Abstracted water would be pumped into the nearby Thames-Lee Tunnel for

transfer to Lockwood pumping station, part of Thames Water’s Lee Valley reservoirs in North London. The scheme reduces the final effluent at the extant Mogden STW outfall to the estuarine Thames Tideway.

The Teddington DRA scheme has been assessed for Gate 2 independently at 50 MI/d, 75 MI/d, 100 MI/d and 150 MI/d

1.2 THE PURPOSE OF THIS REPORT

The purpose of this series of Assessment Reports is to set out the environmental baseline for each reach of the full study area to identify the source of greatest potential magnitude of change that a London Effluent Reuse SRO might cause within that reach, and then assess the potential for change to environmental receptors (aquatic ecology). The report identifies where additional data and/or more detailed analysis is required in Gate 3 as the London Effluent Reuse SRO designs are developed and operating regimes refined. The findings of these reports provide the evidence base to inform the HRA, Water Framework Directive (WFD) and IEA assessments.

This report provides the assessment for the Gate 2 aquatic ecology topic. As per the Gate 2 Aquatic Ecology Evidence Report, Table 1-1 outlines the task and approach to assessment for the aquatic ecology assessment for Gate 2 of the London Effluent Reuse SRO. It also outlines the evidence base that has been used to undertake the assessment for each of the tasks.

The study area for the London Effluent Reuse SRO has been divided into the following water courses (Figure 1-1):

- The freshwater River Thames from Shepperton Weir to the tidal limit at Teddington
 - Reach A – Shepperton Weir to Affinity Water Walton Intake
 - Reach B – Affinity Water Walton Intake to Thames Water Walton Intake
 - Reach C – Thames Water Walton Intake to Teddington Weir
- Channels of the freshwater Lee from Newman’s Weir on the Enfield Island Loop to the tidal limit at Three Mills Lock
 - Reach G – Newmans Weir on the Enfield Island Loop to Chingford Abstractions
 - Reach H – Chingford Abstractions to Three Mills Lock
- The estuarine Thames Tideway from the tidal limit at Teddington to 3km seawards of Beckton STW outfall, noting the estuarine model boundary is at Southend-on-Sea.
 - Reach D – Teddington Weir to Battersea Park
 - Reach E – Battersea Park to Tower Bridge
 - Reach F - Tower Bridge to 3km seawards of Beckton STW
- The estuarine Bow Creek (tidal Lee) from Three Mills Lock to the Thames Tideway.
 - Reach I - Three Mills Lock to Thames Tideway

Section 2 of this report sets out reference conditions for the zone of influence of the London Effluent Reuse SRO sub-options. Sections 3-5 outlines the environmental assessment for each SRO sub-option included in the Gate 2 submission. Section 6 provides summary of current knowledge gaps and future investigations.

Figure 1-1 Map showing locations of schemes and reaches for London Effluent Reuse SRO

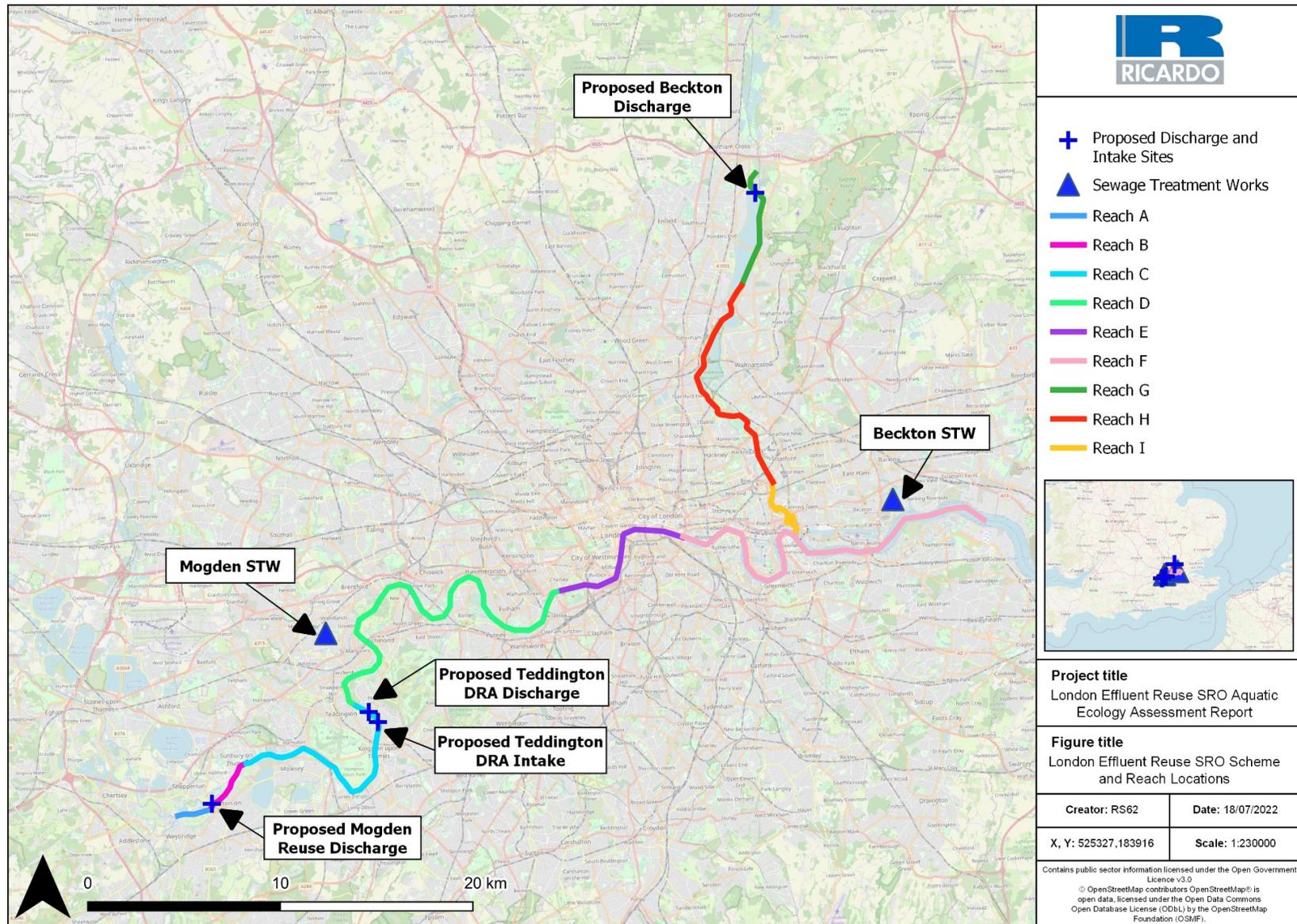


Table 1-1 Tasks and assessment approach to the aquatic ecology assessment for London Effluent Reuse SRO

Task item	Scope of assessment	Approach to assessment	Evidence Base for Task
<p>a. Aquatic invertebrates Freshwater and Estuarine</p>	<ul style="list-style-type: none"> Update the Gate 1 assessment using additional baseline data collected during Gate 1 and Gate 2. 	<ul style="list-style-type: none"> Review additional studies on temperature related impacts on aquatic invertebrates to understand the potential risks. Review modelling interpretation to determine significance of temperature changes (seasonal <i>and</i> average). Review modelling to consider the extent of the mixing zone downstream of discharge locations. Update assessment in consideration of the interpretation of the fluvial conditions within the Lower Thames and Thames Tideway. Studies will include an assessment of reuse discharge, water levels and velocity patterns throughout the study area (both river and estuary) for the range of reference conditions and scenarios with reuse scheme and the likely effect on a community scale if this is shown to be extensive. Update assessment to consider modelled information on marginal exposure in the estuary. Update assessment in consideration of the interpretation of the water quality assessment. Suggest further mitigation measures (where required) for design/engineering interface. 	<ul style="list-style-type: none"> Annual monitoring (spring and autumn) during 2021 and 2022 at 14 freshwater sites within the project area. Annual monitoring (spring and autumn) at four estuarine sites during 2020 and 2021 within the project area . Review of data from Environment Agency Ecology & Fish Data Explorer from 2011-2021. Analysis of both EA and Ricardo invertebrate data using WHPT scores, ASPT, NST, LIFE and PSI thresholds Depressed river mussel surveys at three sites during 2021 to 2022. Supported by two years of INNS monitoring at 24 sites during spring and summer (2021 to 2022). Physical Environment and Water quality assessments will provide scenario outputs for each of the SRO schemes.
<p>b. Marginal habitat assessment</p>	<ul style="list-style-type: none"> Update the Gate 1 assessment using additional baseline data collected during Gate 2 	<ul style="list-style-type: none"> Update assessment in consideration of the interpretation of the fluvial (flow) model, including the fluvial flow series at key locations to consider the risk of water level changes. Include relevant SRO monitoring programme survey data such as ADCP and River MoRPh survey outputs. Suggest further mitigation measures (where required) for design/engineering interface. 	<ul style="list-style-type: none"> UKHab surveys within eight reaches within lower Thames in 2021. UKHab surveys within four reaches within Barking Creek/undertaken in 2022. UKHab surveys within one reach of the River Lee in 2022. Supported by two years of INNS monitoring at 24 sites during spring and summer (2021 to 2022). Physical Environment and Water quality assessments will provide scenario outputs for each of the SRO schemes.
<p>c. Plants/diatoms</p>	<ul style="list-style-type: none"> Update the Gate 1 assessment using additional baseline data collected during Gate 1 and Gate 2 	<ul style="list-style-type: none"> Review and interpret results from the ongoing algal monitoring programme. Review modelling in Gate 2 to determine significance of temperature changes (seasonal and average) to confirm risk to increasing productivity. Further review of literature is available to confirm the risks of temperature change. Update assessment in consideration of the interpretation of the water quality assessment, including temperature (if applicable based on review) and nutrients. Update assessment in consideration of the interpretation of the fluvial conditions within the Lower Thames and Thames Tideway. Studies will include an assessment of reuse discharge, water levels and velocity patterns throughout the study area (both river and estuary) for the range of reference conditions and scenarios with reuse scheme and the likely effect on a community scale if this is shown to be extensive. Suggest further mitigation measures (where required) for design/engineering interface. 	<ul style="list-style-type: none"> Annual monitoring (spring and autumn) during 2021 and 2022 at eight sites within the project area. Review of data from Environment Agency Ecology & Fish Data Explorer from 2011-2021. Supported by two years of INNS monitoring at 24 sites during spring and summer (2021 to 2022) to inform distribution of INN plant species. Physical Environment and Water quality assessments will provide scenario outputs for each of the SRO schemes.

Task item	Scope of assessment	Approach to assessment	Evidence Base for Task
<p>d. Macroalgae, Angiosperm and Phytoplankton</p>	<ul style="list-style-type: none"> Update the Gate 1 assessment using additional baseline data collected during Gate 1 and Gate 2 	<ul style="list-style-type: none"> Review and interpret results from the ongoing algal monitoring programme. Review modelling in Gate 2 to determine significance of temperature changes (seasonal and average) to confirm risk to increasing productivity. Update assessment in consideration of the interpretation of the fluvial conditions within the Lower Thames and Thames Tideway. Studies will include an assessment of reuse discharge, water levels and velocity patterns throughout the study area (both river and estuary) for the range of reference conditions and scenarios with reuse scheme and the likely effect on a community scale if this is shown to be extensive. Update assessment to consider modelled information on marginal exposure and hydromorphology survey data (estuarine MoRPh) in estuary. Assessment of the measured and modelled sediment data. Update assessment in consideration of the interpretation of the water quality assessment. Suggest further mitigation measures (where required) for design/engineering interface. 	<ul style="list-style-type: none"> Four macroalgae/phytoplankton sites surveyed during summer 2021 and summer 2022. Review of data from Environment Agency Ecology & Fish Data Explorer from 2011-2021. Supported by two years of INNS monitoring at 24 sites during spring and summer (2021 to 2022). Physical Environment and Water quality assessments will provide scenario outputs for each of the SRO schemes.
<p>e. Designated and protected sites and species.</p>	<ul style="list-style-type: none"> Update assessment to consider additional baseline information, including information on risk to German hairy snail, depressed river mussel, river margins and terrestrial habitats Assessment to consider the risk associated with hydrological changes from decreased discharge and change in water level potentially resulting in inundation of key habitats (Ham Lands Local nature reserve (LNR), Isleworth Ait LNR, Syon Park Site of Special Scientific Interest (SSSI)) 	<ul style="list-style-type: none"> Update assessment in consideration of the interpretation of the fluvial conditions within the Lower Thames and Thames Tideway. Studies will include an assessment of reuse discharge, water levels and velocity patterns throughout the study area (both river and estuary) for the range of reference conditions and scenarios with reuse scheme. Include relevant SRO monitoring programme survey data such as UKHab survey outputs Update assessment in consideration of the interpretation of the water quality assessment. Suggest further mitigation measures (where required) for design/engineering interface. 	<ul style="list-style-type: none"> UKHab surveys undertaken by Jacobs for the proposed infrastructure location undertaken in 2021. Targeted surveys within Syon Park SSSI, Ham Lands and Isleworth Ait via UK Hab. Physical Environment and Water quality assessments will provide scenario outputs for each of the SRO schemes.

2. BASELINE CONDITIONS

2.1 INTRODUCTION

To inform the assessment for each of the tasks set out in Table 1-1, this section establishes the reference conditions for each task as per the relevant study area. The study area for each task has been set out per task as it is not consistent across tasks. The reference conditions for each of the following tasks has been set out in the following sections:

- Assessment method overview – Section 2.2
- Aquatic invertebrates freshwater – Section 2.3
- Aquatic invertebrates estuarine – Section 2.4
- Marginal habitat assessment – Section 2.5
- Macrophytes – Section 2.6
- Diatoms – Section 2.7
- Macroalgae, Angiosperm and Phytoplankton – Section 2.8
- Designated and Protected sites and species – Section 2.9

This reference conditions assessment has been undertaken for the following for each task:

- Aquatic invertebrates across Reaches A, B and C in the freshwater River Thames, Reaches D, E and F in the estuarine Thames Tideway, Reaches G and H in the freshwater Lee Diversion Channel and Reach I in the estuarine River Lee
- Marginal habitats across Reaches A, B and C in the freshwater River Thames and Reach G in the freshwater Lee Diversion Channel
- Macrophytes across Reaches A, B and C in the freshwater River Thames and Reaches G and H in the freshwater Lee Diversion Channel
- Diatoms across Reaches A, B and C in the freshwater River Thames, Reach E in the estuarine Thames Tideway and Reaches G and H in the freshwater Lee Diversion Channel
- Macroalgae, Angiosperm and Phytoplankton across Reaches D, E and F in the estuarine Thames Tideway
- Designated and protected sites and species across Reaches A, B and C in the freshwater River Thames, Reaches D, E and F in the estuarine Thames Tideway, Reaches G and H in the freshwater Lee Diversion Channel and Reach I in the estuarine River Lee.

Where this report may make reference to A82 and M96 flow series, respectively these refer to 1 in 5 year and 1 in 20-year flow events. Full details of the scenarios selected is provided in Section 1.2 of the Physical Environment Assessment Report³.

A full list of survey sites and data ranges, along with figures presenting survey locations are provided in the Aquatic Ecology Evidence Report⁴. It is noted that data availability means that the same level of baseline data is not available for each assessment.

2.2 ASSESSMENT METHOD OVERVIEW

As noted above in Section 1.1, a full summary for the indicative operating pattern of a London Effluent Reuse SRO is presented in Section 1.2 of the Physical Environment Assessment Report⁵. Within this B.2.4. Gate 2 Aquatic Ecology report it is acknowledged that the variation in operating pattern, both inter and intra scheme, may have differing impacts than those described in the assessment Sections (3 - 5) below. This is due to both the differences in operating months throughout the year and the variances in flows between scheme on and off months. This is considered to primarily affect the invertebrate, macrophytes and diatom communities, as

³ Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Physical Environment Assessment Report.

⁴ Ricardo (2021) London Effluent Strategic Resource Option, Gate 2 Aquatic Ecology Evidence Report

⁵ Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Physical Environment Assessment Report.

these communities experience seasonal related shifts in composition throughout the year. This is captured within the models by the taking of both spring and autumn samples within a year.

While not described in detail here, the impacts during the months the schemes do not operate (and just a small maintenance flow is discharged) are not considered to be significantly different from those described below due to the limited discharge volumes compared to receiving water body flow. This is both due to the assessment within the models and also the physical environment and water quality impacts described and utilised within the assessments. The schemes do not come into operation until after the spring samples and cease operation after the autumn samples. The models combine the two samples into one community and to separate the samples would be to assess against an incomplete data set, this would be particularly limiting in reaches where the sample numbers are low. Further, where a physical environment or water quality parameter is determined to have an impact, this is considered to be occurring during scheme on, and the impact in those physical environment and/or water quality parameters is considered to be considerably less during scheme off. Therefore, when an assessment (below) identifies a potential impact during scheme on, the potential impact during scheme off for that same parameter is considered to be less, i.e. a minor impact may become a negligible impact.

2.2.1 Aquatic Invertebrates

Where potential community scale impacts are identified for the aquatic invertebrate (hereafter referred to as ‘invertebrates’) Water Framework Directive (WFD) element, an impact assessment has been completed in consideration of 10 years (2012 – 2022) of baseline data, including data collected between 2020 and 2022 by Ricardo (see Evidence Report for further details), though there are sites with data available back to 2000. The purpose of the analysis is to establish whether the invertebrate community responds to inter-annual changes in flow and other environmental variables (including water quality) by considering the WFD biological metrics/indices data for existing monitoring sites.

The biological indices and metrics considered includes the following:

- **WHPT (Whalley Hawkes Paisley Trigg) index:** WHPT was introduced as the basis for the UK's river invertebrate status classification under the Water Framework Directive for River Basin Management Plan 2 and is described in Environment Agency 2015⁶. Two indices are derived, Average Score Per Taxon (ASPT) and Number of Scoring Taxa (NST). The ASPT of a sample is calculated by dividing the WHPT score by the NST. The ASPT score is considered less sensitive to differences in sampling effort than the WHPT index alone and therefore provides a more reliable means of assessing biological quality.
- **Lotic-invertebrate Index for Flow Evaluation (LIFE):** LIFE is a method for linking invertebrate data to prevailing flow regimes. This is an index designed for British Waters and is described in Extence *et al.*, 1999⁷. It may be calculated either at the family level or at the species level. The index is calculated by assigning each taxa to one of six groups ranging from a group primarily associated with rapid flows to a group holding forms frequently associated with drying or drought impacted sites.
- In line with Extence *et al.*, 1999⁵, the LIFE index for each of the invertebrate communities has been used to inform the flow sensitivity of the invertebrates within each of the key reaches.
- **The Proportion of Sediment-sensitive Invertebrates (PSI):** the PSI index⁸ is an index which measures the abundance-weighted percentage frequency of taxa which are sensitive to fine sediment deposition and has been used to assess the sensitivity of the invertebrate community to changes in geomorphology.

⁶ Environment Agency. 2015. Whalley Hawkes Paisley Trigg (WHPT) index of river invertebrate quality. A brief description of WHPT for river invertebrate assessment in the UK under the water framework directive.

⁷ Extence, C.A., Balbi, D.M. and Chadd, R.P., 1999. River flow indexing using British benthic invertebrates: a framework for setting hydroecological objectives. *Regulated Rivers: Research & Management: An International Journal Devoted to River Research and Management*, 15(6), pp.545-574.

⁸ Glendall *et al.* 2014. Testing the pressure-specific invertebrate index (PSI) as a tool for determining ecological relevant targets for reducing sedimentation in streams

The biological indices and metrics identified above are then used to establish the baseline conditions and variability within the invertebrate communities present in the reaches associated with each London Effluent Reuse scheme.

The expected scores for each index for each of the sample sites from the baseline data set have been generated via River Invertebrate Classification Tool (RICT) for each season, using physical environment data provided by the Environment Agency’s Ecology and Fish Data Explorer⁹. The Observed score (O), also obtained from the Environment Agency’s Ecology and Fish Data Explorer is then divided by the Expected score (E) to produce a O:E ratio which is then assessed against WFD standards (Table 2-1) and relevant, WHPT scores, ASPT, NST, LIFE and PSI thresholds.

Table 2-1 EQR Reference Classifications

WHPT Classification	WHPT _{ASPT} EQR	WHPT _{NTAXA} EQR	LIFE EQR (Non-WFD)	PSI EQR (Non-WFD)
High	>0.97	>0.8	>0.97	>0.8
Good	0.97>0.87	0.8>0.68	0.97>0.94	0.8>0.7
Moderate	0.87>0.72	0.68>0.56	0.94>0.88	0.7>0.6
Poor	0.72>0.53	0.56>0.47	0.88>0.83	0.6>0.5
Bad	<0.53	<0.47	<0.83	<0.5

It is noted that the thresholds to determine whether flow (abstraction) is a stressor for the invertebrate community for soft water / non-chalk streams the threshold is 0.94. As the London Effluent Reuse schemes are most likely to result in increased flow, the result of the baseline community assessment will be considered with caution.

It is noted that certain species may be of particular importance in the associated reaches and impacts on these species will not necessarily be considered as part of a community assessment. As such, the taxon list for each monitoring site used in the baseline data assessment obtained from the Environment Agency’s Ecology and Fish Data Explorer have been used to identify protected/notable species which should be considered separately (e.g., the depressed river mussel, *Pseudanodonta complanata*).

For assessing Depressed River Mussel populations the following approach was taken:

1. The site was split into four sub-sites along the bank of the river, in locations that were identified as having safe access and suitable conditions to sample.
2. A combination of dredge netting, and sweep netting the substrate with a long pole sweep net was used to sample the area.
3. Samples were sorted on the bankside, and identified to species level, and
4. Three surveyors sampling each sub site for 30 minutes resulted in six total man hours of sampling per site. Data is then evaluated on a presence/absence basis for each site and lengths and numbers of depressed river mussel are recorded. No population estimates or biotic indices are calculated for this species as part of the assessment.

2.2.2 Marginal Habitat Assessment

Marginal habitat was assessed using data obtained from River Condition Assessments¹⁰ (RCA).

RCAs were undertaken within areas with potentially sensitive marginal habitat and potentially impacted riverine reaches which could be subject to changes in level and flow (see Evidence Report¹¹ for further details). Surveys

⁹ <https://environment.data.gov.uk/ecology/explorer/>

¹⁰ Gurnell, A. M., England, J., Scott, S. J. & Shuker, L. J. (2020). A guide to assessing river condition. Part of the rivers and streams component of the biodiversity net gain metric. Available at <https://modularriversurvey.org/wp-content/uploads/A-GUIDE-TO-ASSESSING-RIVER-CONDITION-Jly2020.pdf>. (Accessed 04 May 2022).

¹¹ Ricardo (2021) London Effluent Strategic Resource Option, Gate 2 Aquatic Ecology Evidence Report

followed the Modular River Physical (MoRPh) field methodology¹² and aimed to survey at least 20% of the study area to determine the overall condition of the survey reaches and assign a final condition score. The zone of influence on the River Thames was defined from Mogden water recycling outfall structure to Teddington lock (the point at which River Thames becomes estuarine).

The baseline river scores were then adjusted for the associated impacts related to construction and operation. This is assessed following construction, and prior to river re-instatement, and assumes typical good practice construction methods and mitigation will be used, such that potential for downstream effects of construction will be fully mitigated, i.e., there will be no change in river condition. The physical environment modelling outputs and ecological assessments undertaken at Gate 2 identified the rivers and any streams where the risk of impact pathways that could impact on river condition are likely. For those rivers and any streams only, the baseline condition assessment (determined via River MoRPh surveys conducted for Gate 2) were reviewed and amended to reflect potential alterations in positive and negative river condition indicators as a result of the operation of London Effluent Reuse schemes. There are 32 river condition indicators (fully listed within the assessment Tables 3-3, 4-3 and 5-3) which are derived from the field survey and desk study analysis.

2.2.3 Macrophytes

Where potential community scale impacts were identified for the freshwater macrophyte WFD element, an impact assessment was completed in consideration of 12 years (2010 – 2022) of baseline data (see Evidence Report¹³ for further details). The purpose of the analysis is to establish whether the macrophyte community responds to inter-annual changes in flow and other environmental variables (including water quality) by considering the WFD biological metrics/indices data for existing monitoring sites. This informs the sensitivity of the macrophyte community, and the potential impact associated with changes in the physical environment as a result of the various London Effluent Reuse schemes. The macrophyte survey methodology is based on the WFD UK Technical Advisory Group (UKTAG) LEAFPACS2 methodology¹⁴, which is based on the Mean Trophic Rank (MTR) methodology¹⁵.

The biological indices and metrics that will be considered includes the following:

- **River macrophyte hydraulic index (RMHI)**¹⁶: The RMHI describes a plant community's preference for flow conditions. Scores range from 1 to 10 with scores of 10 indicating a preference for very slow flow and scores of 1 indicating a preference for very fast flows.
- **River macrophyte nutrient index (RMNI)**: The RMNI is designed to categorise a macrophyte community's preference to nutrient levels. Scores range from 1 to 10 with scores of 1 representing plant communities with preference for very low levels of nutrients and 10 representing communities with a preference for (or tolerance of) enriched conditions.
- **Number of aquatic taxa (NTAXA)**: A diversity score indicating the number of truly aquatic macrophyte taxa recorded from the field survey.
- **Number of aquatic plant functional groups (NFG)**: A diversity score indicating the number of functional macrophyte groups within the plant community, from a predefined list of 24 different functional groups. Only truly aquatic taxa are included.
- **Cover of green filamentous algae (ALG)**: The percentage cover of green filamentous algae over the whole of the surveyed section of the river.

2.2.4 Diatoms

Where potential community scale impacts are identified for the diatoms WFD element, an impact assessment was completed in consideration of 22 years (2000 – 2022) of baseline data, including data from 2020 to 2022 Ricardo surveys (see Evidence Report¹⁷ for further details). The purpose of the analysis was to establish whether the diatom community responds to inter-annual changes in flow and other environmental variables

¹² Gurnell, A. M., & Shuker, L. J. (2022). The MoRPh Survey. Technical Reference Manual 2022 version. Available at <https://modularriversurvey.org/professional-help/>. (Accessed 04 May 2022).

¹³ Ricardo (2021) London Effluent Strategic Resource Option, Gate 2 Aquatic Ecology Evidence Report

¹⁴ UK Technical Advisory Group (2014). UKTAG River Assessment Method Macrophytes and Phytobenthos. Macrophytes (River LEAFPACS2). July 2014.

¹⁵ Holmes, N.T.H., Newman, J.R., Chadd, S., Rouen, K.J., Saint, L. & Dawson, F.H. (1999). Mean Trophic Rank: A User's Manual. R&D Technical Report E38. Environment Agency, Bristol.

¹⁶ RMHI is no longer used in the WFD assessment but is reported here to be used as a relative comparison between the survey sites within the same watercourse.

¹⁷ Ricardo (2021) London Effluent Strategic Resource Option, Gate 2 Aquatic Ecology Evidence Report

(including water quality) by considering the WFD biological metrics/indices data (Table 2-2) for existing monitoring sites. This informs the sensitivity of the diatom community and the potential impact associated with changes in the physical environment as a result of the various London Effluent Reuse schemes.

The biological indices and metrics that will be considered includes the following:

- **Trophic diatom index (TDI):** An index for monitoring the trophic status of rivers based on diatom composition with scores ranging from 0 (very low nutrients) to 100 (very high nutrients).
- **Proportion of motile taxa (PMT):** Proportion of organic pollution tolerant diatoms in sample
- **Proportion of Saline taxa (PST):** proportion of slightly saline water tolerant diatoms in sample
- **Proportion of Pollution Tolerant Valves (PTV):** Proportion of organic pollution tolerant diatoms in sample

Table 2-2 UK TAG Phytobenthos in Rivers Diatoms for Assessing River and Lake Ecological Quality (DARLEQ2) Reference Classifications

Classification Boundary	TDI4 EQR
High/Good	0.8
Good/Moderate	0.6
Moderate/Poor	0.4
Poor/Bad	0.2

2.2.5 Macroalgae, Angiosperm and Phytoplankton

There is limited macroalgae data available within the upper Thames Tideway and a review of the Environment Agency’s Ecology and Fish Data Explorer has resulted in no data being sourced. The Environment Agency has carried out a presence/absence survey of macroalgae within the upper Thames Tideway (Reach D) in 2014 and within the middle Thames Tideway in 2013 (Reach F) as part of less than 15% screening survey for macroalgae¹⁸. However, these data are not suitable for assessment purposes due to the absence of the required additional data which is required to undertake the assessment. Dedicated macroalgae surveys within the project area (Barking Creek, Beckton, Lee Creek and Isleworth Ait area) were carried out in 2020¹⁹. A repeat of this survey is planned for August 2022 (dates to be confirmed based on spring tide times), the results of which may be available for the second iteration of the report.

The purpose of the analysis is to establish whether the macroalgae community responds to inter-annual changes in flow and other environmental variables (including water quality) by considering the WFD biological metrics/indices data (Table 2-3) for existing monitoring sites. Monitoring for macroalgae is carried out usually between June to September, as close to peak bloom time as is practicable (peak blooms are in August to September). The overall size of algal mats will be estimated by walking around the algal patches with a GPS and randomly placing quadrats to assess the density of mats (% cover within the quadrats) and also biomass (wet weight, g.m⁻²). The intertidal area is assessed and where algae have the potential to grow, this is called the available intertidal habitat (AIH). After calculating the AIH, the biological indices and metrics that will be considered include the following:

- **% Cover of AIH:** This is the percentage cover estimated from the quadrats measured over all of the macroalgal patches of the AIH.
- **Total extent of algal bloom (Affected Area, AA):** This is a measure of the total area affected by the algal bloom and is measured in hectares.
- **AA/AIH (%):** Calculation of the affected area as a percentage of the AIH, but only using the worse of these two measures, which helps to adjust the impact to the size of the waterbody.
- **Average biomass of the AA:** Opportunistic macroalgae are cut and peeled from the surface of each quadrat, washed and weighed wet.

¹⁸ Mark Davison, *Pers. Comm*

¹⁹ Atkins (2020). Thames Water SROs - Thames Tideway Macroalgae survey report_02122020.

- **Average biomass of available AIH:** This is the estimate of the average biomass of algae over the whole of the AIH.
- **Proportion of entrained algae:** This is an estimate of the percentage of quadrats where algae grow at depths >3 cm into the underlying sediment.

Table 2-3 EQR reference classifications

Quality status	High	Good	Moderate	Poor	Bad
EQR	1 - >0.8	<0.8 - >0.6	<0.6 - >0.4	<0.4 - >0.2	<0.2 - 0.0
% cover of Available intertidal habitat (AIH)	≥0 - <5	≥5 - ,15	≥15 -,25	≥25 - ,75	≥75 - 100
Average biomass (g/m ²) of AIH	≥0 - <100	≥100 - 500	≥500 - 1000	≥1000 - 3000	≥3000 (- 6,000)
Average biomass (g/m ²) of total area covered by macroalgae (AA)	≥0 - <100	≥100 - 500	≥500 - 1000	≥1000 - 3000	≥3000 (- 6,000)
AA (hectares)*	≥0 - <10	≥10 - 50	≥50 - 100	≥100 - 250	≥250 (- 6,000)
AA/AIH (%)*	≥0 - <5	≥5 - 15	≥15 - 50	≥50 - 75	≥75 - 100
% entrained algae	≥0 - <1	≥1 - 5	≥5 - 20	≥20 - 50	≥50 - 100

* N.B. Only the lower EQR of the two metrics, AA or AA/AIH should be used in the final EQR calculation

Dedicated WFD angiosperm monitoring within the Upper and Middle Thames Tideway transitional water body has not been considered as part of the Gate 2 monitoring within the project area. This is due to freshwater tidal nature of the Upper Tideway and the mesohaline nature of the Middle Tideway associated with Barking Creek. Lower Thames Tideway angiosperm data has been obtained from the Environment Agency²⁰ but given the location of the angiosperm beds within the outer Thames estuary (approx. Canvey Island area) and no impact pathways present, the marine angiosperms have not been considered further within this assessment.

The WFD requires that the assessment of the phytoplankton quality element considers composition, abundance, biomass and planktonic blooms. Where potential community scale impacts are identified for the phytoplankton WFD element, an impact assessment was completed in consideration of six years (2015 – 2021) of baseline data. The purpose of the analysis was to establish whether the phytoplankton community responds to inter-annual changes in physical environment and water quality by considering the WFD biological metrics/indices data (Table 2-4) for existing monitoring sites. This informs the sensitivity of the phytoplankton community and the potential impact associated with changes in the physical environment as a result of the various London Effluent Reuse schemes.

The biological indices and metrics that will be considered includes the following:

- **Chlorophyll-a 90th percentile:** The calculation of the 90th percentile value of daily averaged chlorophyll-a biomass over the growing season (March to October, inclusive). The value of the 90th percentile is compared against boundary conditions to establish classification status
- **Elevated count multimetric:** This multimetric is based on two metrics measuring the number of occasions that phytoplankton counts exceed an established threshold over the reporting period.

To calculate the phytoplankton metrics, the abundance of identified phytoplankton taxa (identified to an agreed practical taxonomic level), measurement of chlorophyll-a, salinity and supporting parameters (e.g. turbidity) are required.

²⁰ Emails from Mark Davison: 10th to 13th January 2022 and results from EA monitoring 2013 to 2019. Note that TraC angiosperm data is not available via the EA Ecology & Fish Data Explorer,

Table 2-4 Overall ecological status boundaries for the TW phytoplankton tool

Quality status	EQR
High/Good	0.8
Good/Moderate	0.6
Moderate Poor	0.4
Poor/Bad	0.2

2.2.6 Designated and protected sites and species

Geographic Information System (GIS) was used to confirm the presence of any internationally, nationally or locally protected sites hydrologically connected or within the zone of influence of each London Effluent Reuse schemes. The protected sites include Special Areas of Conservation (SACs)²¹, Special Protected Areas (SPAs)²², Ramsar sites²³, Site of Special Scientific Interest (SSSIs), Marine Conservation Zones (MCZs), National Nature Reserves (NNR), Local Nature Reserves (LNRs) and NERC Act Section 41 habitats of principal importance (priority habitats) within each reach.

Then professional judgement, informed by relevant information on the ecological requirements for each habitat/species, was used to assess the sensitivity and the impacts associated with each scheme. To provide an indication of the sensitivity of the protected site to the physical environment changes identified, a number of data sources were considered, including:

Relevant citation documents;

- Conservation objectives (Special Areas of Conservation and Special Protection Areas) and Supplementary Advice (where available) including the targets and attributes that inform favourable condition status;
- Site Improvement Plans (Special Areas of Conservation and Special Protection Areas);
- Regulation 33 information for European Marine Sites;
- Review of Consents information available from the Environment Agency;
- Favourable condition tables for Sites of Special Scientific Interest;
- Article 12 (Special Protection Areas) and Article 17 (Special Areas of Conservation) status reports;
- Sites of Special Scientific Interest condition assessments;
- SSSI impact Risk zones (IRZ);
- Common Standards Monitoring Guidance (where specific targets have been set and agreed by Natural England and Environment Agency);
- Habitat preferences for the qualifying species (e.g. nesting, foraging, commuting) and food preferences; and
- Physical characteristics of the habitats and environment influencing them.

Where required, baseline data obtained through the Environment Agency and Thames Water monitoring programmes was used to supplement the data sources listed above to further inform the presence and/or distribution of qualifying features with the study area associated with each scheme. As an initial guide, the UK Technical Advisory Group on the Water Framework Directive Guidance on the Identification of Natural

²¹ Special Areas of Conservation (SACs) are strictly protected sites designated under the EC Habitats Directive. Article 3 of the Habitats Directive requires the establishment of a European network of important high-quality conservation sites that will make a significant contribution to conserving the 189 habitat types and 788 species identified in Annexes I and II of the Directive (as amended). www.jncc.org.uk

²² Special Protection Areas (SPAs) are strictly protected sites classified in accordance with Article 4 of the EC Directive on the conservation of wild birds (79/409/EEC), also known as the Birds Directive, which came into force in April 1979. They are classified for rare and vulnerable birds, listed in Annex I to the Birds Directive, and for regularly occurring migratory species. www.jncc.org.uk

²³ Ramsar sites are wetlands of international importance designated under the Ramsar Convention

Protected Areas (final) March 2003²⁴, was used to identify water dependent features (although noting these cover habitats and species also reliant on coastal processes).

2.3 AQUATIC INVERTEBRATES FRESHWATER

2.3.1 Overview

This section sets out the reference conditions for the freshwater invertebrates:

- Freshwater River Thames - Section 2.3.2
- Freshwater Lee Diversion Channel - Section 2.3.3

The evidence available, the general patterns observed in the data and any notable pressures are outlined for each of these reaches in the following sections.

2.3.2 Freshwater River Thames

Reach A – Shepperton Weir to Affinity Water Walton Intake

The WFD water body GB106039023232 (Thames (Egham to Teddington)) is classified as 'poor for invertebrates in 2019 under Cycle 2²⁵.

The EA has collected invertebrate data at two locations within Reach A on the freshwater River Thames between 2017 and 2021 (Table 2-5). For Reach A these sites are LRUS - 010/EA Site ID188055 and LRUS - 001/EA Site ID197071.

The available invertebrate data within the zone of influence is, generally, considered sufficient to provide an indication of the baseline community. Additional surveys are suggested at both sites to provide a more robust baseline.

Following completion of the Gate 1 assessment, targeted surveys were completed for the length of the River Thames and also at key locations downstream on behalf of the London Effluent Reuse SRO (see Section 6.2 for details of sites).

Baseline LIFE data indicates that under present conditions, the invertebrate community in the impacted reach is not sensitive to reduced flows (Figure 2-1). See Table 2-1 above (Section 2.2) for guidance in interpreting raw LIFE scores.

WHPT and PSI Ecological Quality Ratio (EQR) scores (Table 2-1) are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for WHPT_{NTAXA} and WHPT_{ASPT}, see Figure 2-1.

WHPT_{ASPT} and WHPT_{NTAXA} scores were available for two sites. Data from the monitoring sites shows little variation in WHPT_{ASPT} scores over the period 2017 to 2021 and are consistent for the standard to achieve poor to moderate WFD status over the monitoring period. WHPT_{ASPT} scores from the sites identifies invertebrate communities which are composed of a good proportion of taxa, which are generally not sensitive to water quality pressures. Samples collected in 2021 suggest a slight deterioration to the standards previously sampled (achieving poor ASPT score), however more data needs to be collected to confirm whether the community has been impaired by water quality pressures in the longer term.

The baseline data suggest that the invertebrate community within the reach from Shepperton Lock to Affinity Water Walton Intake is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slow flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). The invertebrate communities in Reach A have not indicated they are adversely affected by flow stress, with O:E LIFE EQR scores (Table 2-5) in exceedance of the flow pressure threshold (0.94) at both sites. O:E WHPT_{ASPT} and WHPT_{NTAXA} EQR scores (Table 2-5) exceeded the 'Good/Moderate' boundary on all three occasions, which infers that the observed community is one that is expected to be present at this site and is not being adversely affected by stressors such as reduced water quality. The invertebrate communities present at both monitoring sites have not indicated they are being

²⁴ UK Technical Advisory Group (UKTAG) (2003). UK Technical Advisory Group on The Water Framework Directive. Guidance on the Identification of Natura Protected Areas [Final]. Published 30 March 2003.

²⁵ <https://environment.data.gov.uk/catchment-planning>

affected by fine sediment stress, with the O:E PSI EQR scores (Table 2-5) in exceedance of the ‘Good/Moderate’ boundary at both sites.

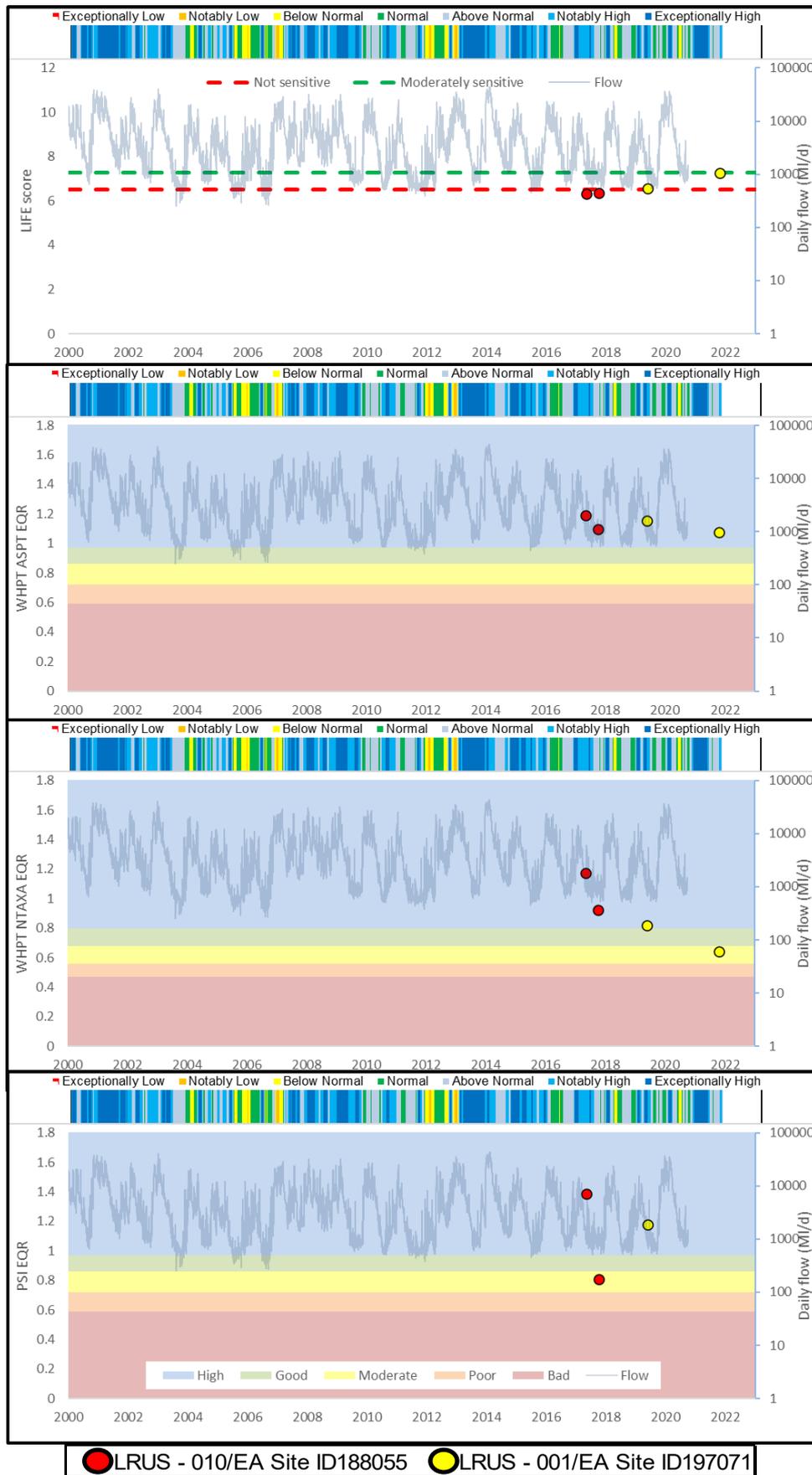
PSI scores suggest that the available habitat was either ‘sedimented’, ‘moderately sedimented’ or ‘heavily sedimented’, which is typical for a large lowland watercourse such as the freshwater River Thames

Invertebrates of interest were recorded in the freshwater River Thames along this reach including *Stenelmis canaliculata* and *Ephemera lineata*. *Ephemera lineata* is considered Vulnerable by IUCN Red list whilst *Ephemera lineata* is considered Vulnerable by IUCN Red list and Nationally Scarce. Details on protected species can be found in Section 2.9.

Table 2-5 Biological indices for monitoring sites in Reach A

Site Order	1	2
SITE_ID	LRUS - 010/EA Site ID188055	LRUS - 001/EA Site ID197071
Survey count	2	2
Min survey year	08/05/2017	21/05/2019
Max survey year	02/10/2017	25/10/2021
LIFE SCORE MAX	1.032919	1.179317
LIFE SCORE MAX class	High	High
LIFE SCORE MIN		1.065452
LIFE SCORE MIN class		High
LIFE SCORE MEAN	1.029666	1.122385
LIFE SCORE MEAN class	High	High
WHPT _{ASPT} EQR MAX	1.191541	1.151823
WHPT _{ASPT} EQR MAX class	High	High
WHPT _{ASPT} EQR MIN	1.098865	1.073858
WHPT _{ASPT} EQR MIN class	High	High
WHPT _{ASPT} EQR MEAN	1.145203	1.11284
WHPT _{ASPT} EQR MEAN class	High	High
WHPT _{NTAXA} EQR MAX	1.174611	0.818668
WHPT _{NTAXA} EQR MAX class	High	High
WHPT _{NTAXA} EQR MIN	0.925451	0.640697
WHPT _{NTAXA} EQR MIN class	High	Moderate
WHPT _{NTAXA} EQR MEAN	1.050031	0.729683
WHPT _{NTAXA} EQR MEAN class	High	Good
PSI MAX	1.387742	2.181116
PSI MAX class	High	High
PSI MIN	0.807333	1.177134
PSI MIN class	High	High
PSI MEAN	1.097538	1.679125
PSI MEAN class	High	High

Figure 2-1 Aquatic invertebrate baseline data for Reach A in 2000-2022. In order: LIFE, WHPT_{ASPT}, WHPT_{NTAXA} and PSI



Reach B – Affinity Water Walton Intake to Thames Water Walton Intake

The WFD water body GB106039023232 (Thames (Egham to Teddington)) is classified as 'poor' for invertebrates in 2019 under Cycle 2²⁶.

The EA has collected invertebrate data at four locations within Reach B on the freshwater River Thames between 2000 and 2021 (Table 2-6). For Reach B these sites are ID 197072, LRUS – 002, 35886 and LRUS – 003/184233.

The available invertebrate data within the zone of influence is, generally, considered sufficient to provide an indication of the baseline community. This is because a long-term data set is available for one site, however, additional surveys are required at selected sites to provide a more robust baseline.

Following completion of the Gate 1 assessment, targeted surveys were completed for the length of the River Thames and also at key locations downstream on behalf of the LRU Group (see Section 6.2 for details of sites).

Baseline LIFE data indicates that under present conditions, the invertebrate community in the impacted reach is not sensitive to reduced flows (Figure 2-2). See Table 2-1 for guidance in interpreting raw LIFE scores.

WHPT and PSI EQR scores (Table 2-1) are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for WHPT_{NTAXA} and WHPT_{ASPT}, see Table 2-6.

WHPT_{ASPT} and WHPT_{NTAXA} scores were available for four sites and show little variation in WHPT_{ASPT} scores over the period 2000 to 2021. These are consistent for the standard to achieve poor or moderate WFD status over the monitoring period. WHPT_{ASPT} scores from the site identifies invertebrate communities which are composed of a good proportion of taxa, which are generally not sensitive to pressures. Samples collected in 2021 suggest a slight deterioration to the standards previously sampled (achieving very poor), however more data needs to be collected to confirm that the community has been impaired by water quality pressures recently.

The baseline data suggest that the invertebrate community within the reach from Affinity Water Walton Intake to Thames Water Walton Intake is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slow flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). The Ecological Quality Ratios (EQRs) for the London Effluent Reuse SRO monitoring locations are indicative of high ecological status for O:E WHPT_{ASPT} scores (Table 2-6) (i.e., the community composition is better than expected based on the baseline physical environment characteristics and are not being adversely affected by pressures other than flow or water quality). However, there are a number of occurrences where the O:E PSI EQR scores (Table 2-3) at EA Site ID35886 fall below the 'Good/Moderate' boundary, but there doesn't appear to be a long-term trend indicating sediment pressure.

Invertebrates of interest were recorded in the freshwater River Thames along this reach including *Ephemera lineata* and *Pseudanodonta complanata*. *Ephemera lineata* is considered Vulnerable by ICUN Red list and Nationally Scarce whilst *Pseudanodonta complanata* is considered a priority species. Details on protected species can be found in Section 2.9.

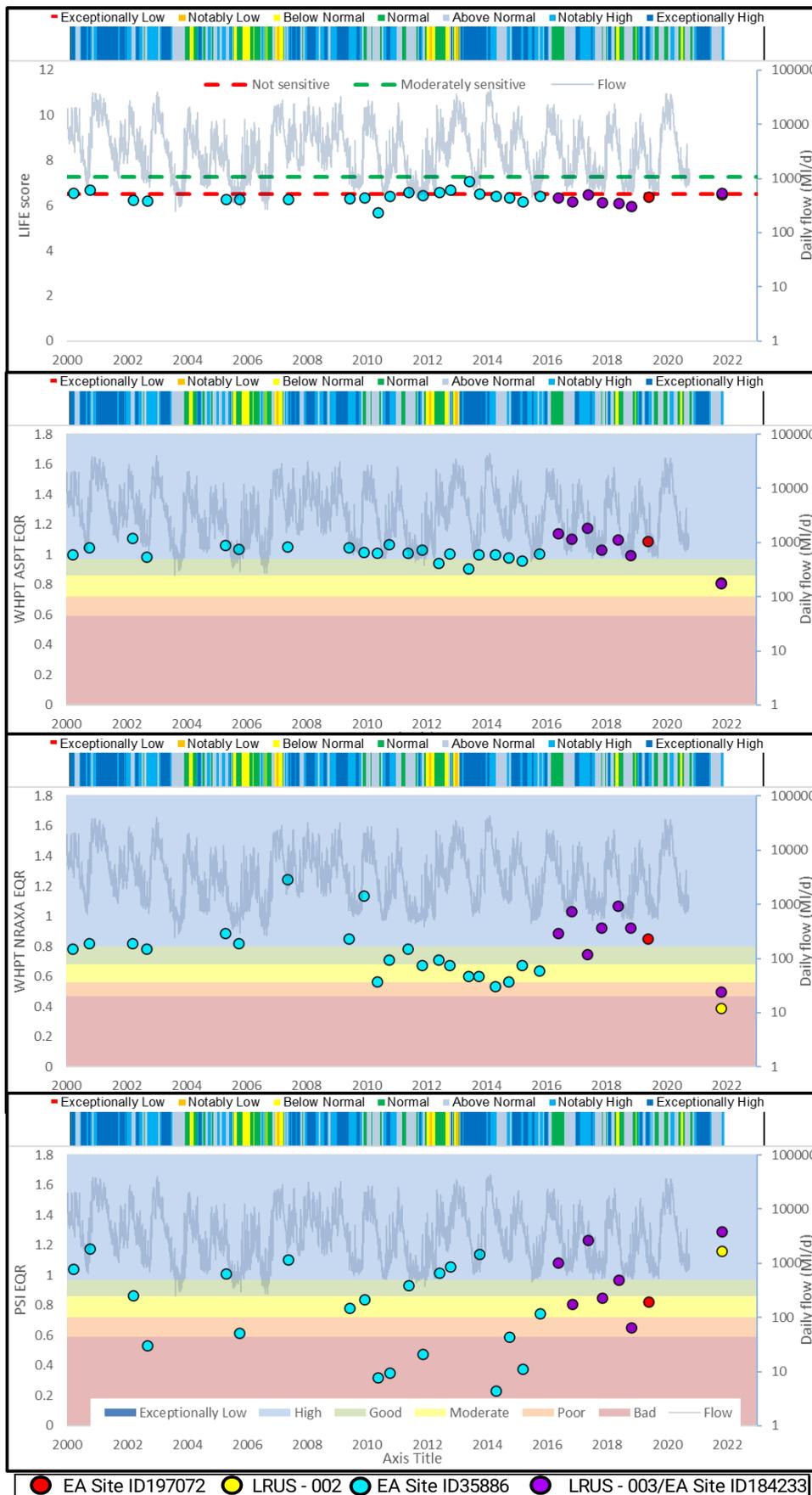
PSI scores (Table 2-6) suggest that the available habitat was either 'sedimented' or 'heavily sedimented', which is typical for a large lowland watercourse such as the freshwater River Thames.

²⁶ <https://environment.data.gov.uk/catchment-planning>

Table 2-6 Biological indices for monitoring sites in Reach B

Site Order	1	2	3	4
SITE_ID	EA Site ID197072	LRUS - 002	EA Site ID35886	LRUS - 003/EA Site ID184233
Survey count	1	1	21	7
Min survey year	21/05/2019	25/10/2021	17/03/2000	19/10/2018
Max survey year	21/05/2019	25/10/2021	07/10/2015	26/10/2021
LIFE SCORE MAX	1.037799	1.057319	1.150038	1.064713
LIFE SCORE MAX class	High	High	High	High
LIFE SCORE MIN	1.037799	1.057319	0.928814	0.96948
LIFE SCORE MIN class	High	High	Moderate	Good
LIFE SCORE MEAN	1.037799	1.057319	1.043531	1.017244
LIFE SCORE MEAN class	High	High	High	High
WHPT _{ASPT} EQR MAX	1.087833	0.81442	1.109898	1.176095
WHPT _{ASPT} EQR MAX class	High	Moderate	High	High
WHPT _{ASPT} EQR MIN	1.087833	0.81442	0.909102	0.806969
WHPT _{ASPT} EQR MIN class	High	Moderate	Good	Moderate
WHPT _{ASPT} EQR MEAN	1.087833	0.81442	1.014701	1.051492
WHPT _{ASPT} EQR MEAN class	High	Moderate	High	High
HPT _{NTAXA} EQR MAX	0.854263	0.391537	1.2458	1.067828
HPT _{NTAXA} EQR MAX class	High	Bad	High	High
HPT _{NTAXA} EQR MIN	0.854263	0.391537	0.533914	0.49832
HPT _{NTAXA} EQR MIN class	High	Bad	Poor	Poor
HPT _{NTAXA} EQR MEAN	0.854263	0.391537	0.75765	0.869517
WHPT _{NTAXA} EQR MEAN class	High	Bad	Good	High
PSI MAX	0.824142	1.163262	1.812915	1.289703
PSI MAX class	High	High	High	High
PSI MIN	0.824142	1.163262	0.235328	0.653084
PSI MIN class	High	High	Bad	Moderate
PSI MEAN	0.824142	1.163262	0.811971	0.985149
PSI MEAN class	High	High	High	High

Figure 2-2 Aquatic invertebrate baseline data for Reach B in 2000-2022. In order: LIFE, WHPT_{ASPT}, WHPT_{NTAXA} and PSI



Reach C – Thames Water Walton Intake to Teddington Weir

The WFD water body GB106039023232 (Thames (Egham to Teddington)) is classified as 'poor for invertebrates in 2019 under Cycle 2'²⁷.

The EA has collected invertebrate data at 10 locations within Reach C on the freshwater River Thames between 2000 and 2021 (Table 2-7). For Reach C these sites are LRUS - 008 (previously T7), LRUS – 004, EA Site ID34367, EA Site ID34368, LRUS - 005/EA Site ID35900, LRUS - 006/EA Site ID188056, LRUS - 009 (previously T8), and EA Site ID35861, as well as ID LRUS - 010/EA Site ID188055 and LRUS - 001/EA Site ID197071.

The available invertebrate data within the zone of influence is, generally, considered sufficient to provide an indication of the baseline community. This is because a long-term data set is available for one site, however, additional surveys are required at selected sites to provide a more robust baseline.

Following completion of the Gate 1 assessment, targeted surveys were completed for the length of the River Thames and also at key locations downstream on behalf of the London Effluent Reuse SRO (see Section 6.2 for details of sites).

Baseline LIFE data indicates that under present conditions, the invertebrate community in the impacted reach is not sensitive to reduced flows (Figure 2-3). See Table 2-1 for guidance in interpreting raw LIFE scores.

WHPT and PSI EQR scores (Table 2-7) are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for WHPT_{NTAXA} and WHPT_{ASPT}, see Figure 2-3.

WHPT_{ASPT} and WHPT_{NTAXA} scores were available for eight sites. Data from the monitoring site shows little variation in WHPT_{ASPT} scores over the period 2000 to 2021 and are consistent for the standard to achieve very poor to moderate WFD status over the monitoring period. WHPT_{NTAXA} and WHPT_{ASPT} scores from the site identifies invertebrate communities which are composed of a good proportion of taxa, which are not being adversely impacted by water quality.

The baseline data suggest that the invertebrate community within the reach from Thames Water Walton Intake to Teddington Weir is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slower flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). O:E LIFE EQR scores (Table 2-7) equal to or in exceedance of the flow pressure threshold (0.94) across all sites. O:E WHPT_{ASPT} EQR scores (Table 2-7) exceeded the 'Good/Moderate' boundary on all sampling occasions, which infers that the observed community is one that is expected to be present at this site and are not being adversely affected by stressors such as reduced water quality. O:E WHPT_{NTAXA} EQR scores (Table 2-7) fell below the 'Good/Moderate' boundary on a number of occasions at multiple sites, which indicates that certain sites are being adversely affected by pressures other than flow or water quality.

PSI scores at all sites (Table 2-7) suggest that the available habitat was either 'sedimented' or 'heavily sedimented', which is typical for a large lowland watercourse such as the freshwater River Thames.

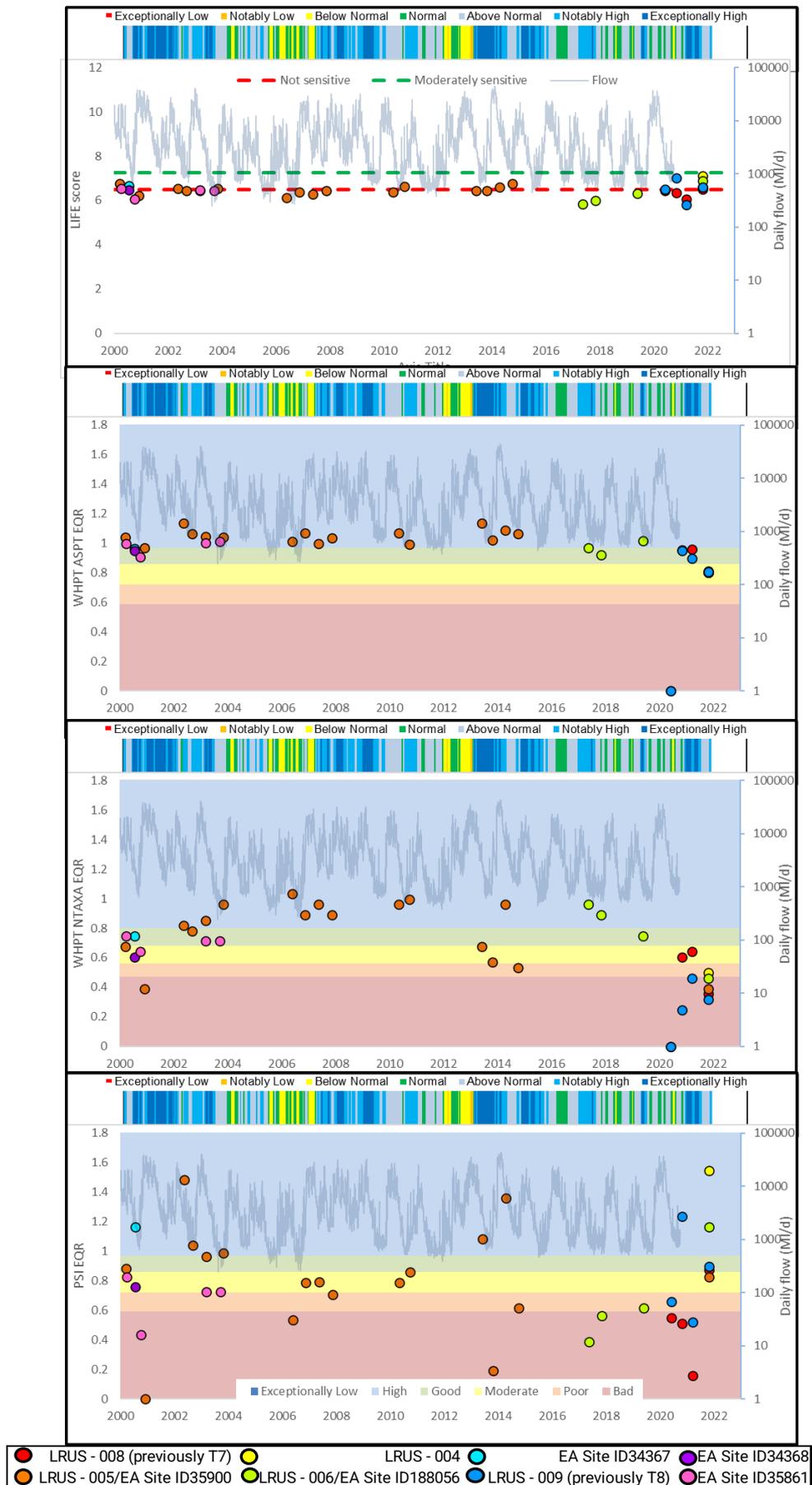
Invertebrates of interest were recorded in the freshwater River Thames along this reach including *Stenelmis canaliculata* and *Ephemera lineata*. *Ephemera lineata* is considered Vulnerable by ICUN Red list whilst *Ephemera lineata* is considered Vulnerable by ICUN Red list and Nationally Scarce. Details on protected species can be found in Section 2.9.

²⁷ <https://environment.data.gov.uk/catchment-planning>

Table 2-7 Biological indices for monitoring sites in Reach C

Site Order	1	2	3	4	5	6	7	8
SITE_ID	LRUS - 008 (previously T7)	LRUS - 004	EA Site ID34367	EA Site ID34368	LRUS - 005/EA Site ID35900	LRUS - 006/EA Site ID188056	LRUS - 009 (previously T8)	EA Site ID35861
Survey count	4	1	1	1	17	4	4	4
Min survey year	28/05/2020	26/10/2021	20/07/2000	20/07/2000	30/09/2014	21/05/2019	26/10/2021	28/03/2000
Max survey year	26/10/2021	26/10/2021	20/07/2000	20/07/2000	26/10/2021	26/10/2021	27/05/2020	12/09/2003
LIFE SCORE MAX	1.057319	1.158984	1.086599	1.052439	1.101238	1.122385	1.138651	1.062199
LIFE SCORE MAX class	High	High	High	High	High	High	High	High
LIFE SCORE MIN	0.987373	1.158984	1.086599	1.052439	0.995507	0.94996	0.946707	0.985747
LIFE SCORE MIN class	High	High	High	High	High	Good	Good	High
LIFE SCORE MEAN	1.031293	1.158984	1.086599	1.052439	1.052726	1.01828	1.054066	1.036986
LIFE SCORE MEAN class	High	High	High	High	High	High	High	High
WHPT _{ASPT} EQR MAX	0.959852	0.803817	0.964265	0.94882	1.138583	1.015016	0.94882	1.010603
WHPT _{ASPT} EQR MAX class	Good	Moderate	Good	Good	High	High	Good	High
WHPT _{ASPT} EQR MIN	-	0.803817	0.964265	0.94882	0.802384	0.804545	-	0.906895
WHPT _{ASPT} EQR MIN class	-	Moderate	Good	Good	Moderate	Moderate	-	Good
WHPT _{ASPT} EQR MEAN	0.681794	0.803817	0.964265	0.94882	1.034958	0.927645	0.664372	0.979711
WHPT _{ASPT} EQR MEAN class	Poor	Moderate	Good	Good	High	Good	Poor	High
HPT _{NTAXA} EQR MAX	0.640697	0.49832	0.74748	0.605103	1.032234	0.961046	0.462726	0.74748
HPT _{NTAXA} EQR MAX class	Moderate	Poor	Good	Moderate	High	High	Bad	Good
HPT _{NTAXA} EQR MIN	-	0.49832	0.74748	0.605103	0.391537	0.462726	-	0.640697
HPT _{NTAXA} EQR MIN class	-	Poor	Good	Moderate	Bad	Bad	-	Moderate
HPT _{NTAXA} EQR MEAN	0.400436	0.49832	0.74748	0.605103	0.785168	0.765277	0.258059	0.702987
WHPT _{NTAXA} EQR MEAN class	Bad	Poor	Good	Moderate	Good	Good	Bad	Good
PSI MAX	0.872446	1.544957	1.163291	0.760366	1.483159	1.163262	1.235966	0.824142
PSI MAX class	High	High	High	Good	High	High	High	High
PSI MIN	0.159687	1.544957	1.163291	0.760366		0.387599	0.520589	0.436049
PSI MIN class	Bad	High	High	Good		Bad	Poor	Bad
PSI MEAN	0.523148	1.544957	1.163291	0.760366	0.817734	0.682617	0.828614	0.678669
PSI MEAN class	Poor	High	High	Good	High	Moderate	High	Moderate

Figure 2-3 Aquatic invertebrate baseline data for Reach C 2000-2022. In order: LIFE, WHPT_{ASPT}, WHPT_{NTAXA} and PSI



2.3.3 Freshwater Lee Diversion Channel

Reach G – Newmans Weir on the Enfield Island Loop to Chingford Abstractions

The WFD water body GB106038027950 (Lea Navigation Enfield Lock to Tottenham Locks Water Body) is classified as 'moderate' for invertebrates in 2019 under Cycle 2²⁸.

The EA has collected invertebrate data at two locations within Reach G on the freshwater Lee Diversion channel between 2000 and 2021 (Table 2-8). For Reach G these sites are ID LRUS – 016 and 33816.

The available invertebrate data within the zone of influence is, generally, considered sufficient to provide an indication of the baseline community. However, additional surveys are suggested at selected sites to provide a more robust baseline.

Following completion of the Gate 1 assessment, targeted surveys were completed for the length of the River Lee and also at key locations downstream on behalf of the London Effluent Reuse SRO (see Section 6.2 for details of sites).

Baseline LIFE data indicates that under present conditions, the invertebrate community in the impacted reach is not sensitive to reduced flows (Figure 2-4). See Table 2-1 for guidance in interpreting raw LIFE scores.

WHPT and PSI EQR scores (Table 2-8) are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for WHPT_{NTAXA} and WHPT_{ASPT}, see Figure 2-4.

WHPT_{ASPT} and WHPT_{NTAXA} scores were available for the two sites. Data from the monitoring site shows little variation in WHPT_{ASPT} scores over the period 2000 to 2021 are consistent for the standard to achieve bad WFD status over the monitoring period. WHPT_{ASPT} scores from the site identifies invertebrate communities which are composed of a small number of taxa which are not sensitive to pressures. There are no instances of deterioration to this standard during the monitoring period as such the community is not expected to have been impaired by water quality pressures historically.

The baseline data suggest that the invertebrate community within the reach from EIL to Chingford abstractions is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for faster flowing water in the most recent sample and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). O:E WHPT_{NTAXA} EQR score (Table 2-8) did not exceed the 'Good/Moderate' boundary on the most recent sample. This indicates that the site may be being intermittently affected by pressures other than flow or water quality.

During surveys in summer 2021 no other invertebrates of interest were recorded in the Lee Diversion Channel along this reach. Details on protected species can be found in Section 2.9.

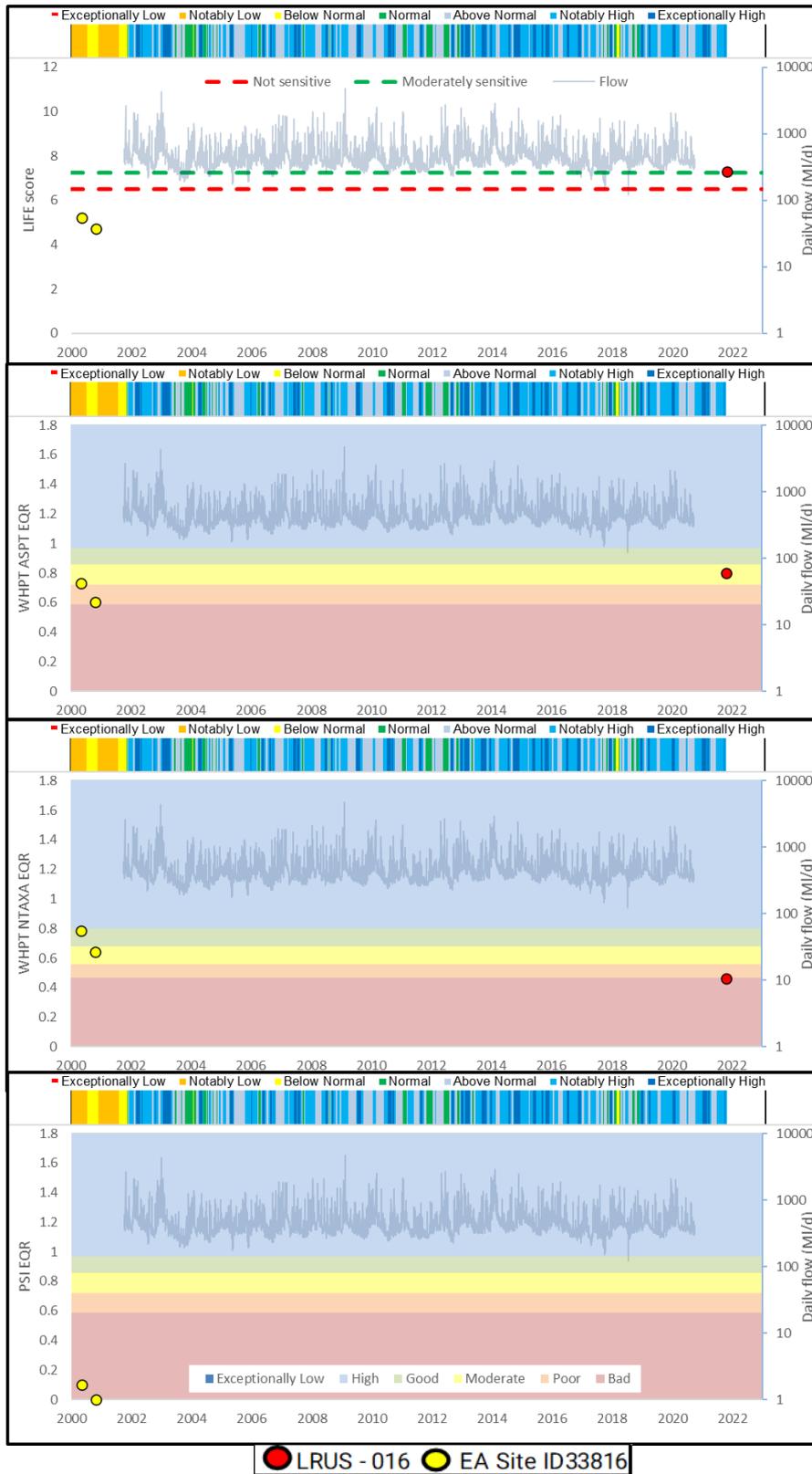
The PSI scores (Table 2-8) suggest that the available habitat was either 'moderately sedimented' or 'heavily sedimented', which is typical for a large lowland depositing river such as the River Lee but is likely to be exacerbated by the King George V abstraction and impoundment by the weir just upstream of the reconnection with the Lee Diversion Channel.

²⁸ <https://environment.data.gov.uk/catchment-planning>

Table 2-8 Biological indices for monitoring sites in Reach G

Site Order	1	2
SITE_ID	LRUS - 016	EA Site ID33816
Survey count	1	2
Min survey year	29/10/2021	08/05/2000
Max survey year	29/10/2021	26/10/2000
LIFE SCORE MAX	1.187451	0.847482
LIFE SCORE MAX class	High	Poor
LIFE SCORE MIN	1.187451	0.769403
LIFE SCORE MIN class	High	Bad
LIFE SCORE MEAN	1.187451	0.808442
LIFE SCORE MEAN class	High	Bad
WHPT _{ASPT} EQR MAX	0.80115	0.732577
WHPT _{ASPT} EQR MAX class	Moderate	Moderate
WHPT _{ASPT} EQR MIN	0.80115	0.60239
WHPT _{ASPT} EQR MIN class	Moderate	Poor
WHPT _{ASPT} EQR MEAN	0.80115	0.667484
WHPT _{ASPT} EQR MEAN class	Moderate	Poor
HPT _{NTAXA} EQR MAX	0.462726	0.783074
HPT _{NTAXA} EQR MAX class	Bad	Good
HPT _{NTAXA} EQR MIN	0.462726	0.640697
HPT _{NTAXA} EQR MIN class	Bad	Moderate
HPT _{NTAXA} EQR MEAN	0.462726	0.711886
WHPT _{NTAXA} EQR MEAN class	Bad	Good
PSI MAX	2.081627	0.100855
PSI MAX class	High	Bad
PSI MIN	2.081627	
PSI MIN class	High	
PSI MEAN	2.081627	0.050427
PSI MEAN class	High	Bad

Figure 2-4 Aquatic invertebrate baseline data for Reach G 2000-2022. In order: LIFE, WHPT_{ASPT}, WHPT_{NTAXA} and PSI



Reach H – Chingford Abstractions to Three Mills Lock

The WFD water bodies GB106038077852 (Lee (Tottenham Locks to Bow Locks/Three Mills Locks)) and GB106038027910 (Pymmes and Salmon Brooks - Deephams STW to Tottenham Locks) are both classified as 'moderate' for invertebrates in 2019 under Cycle 2²⁹.

The EA has collected invertebrate data at four locations within Reach H on the freshwater Lee Diversion channel between 2000 and 2021 (Table 2-9). For Reach H these sites are ID 33816, 33815, 34030, 34160 and ID 154086 (Pymmes Brook).

The available invertebrate data within the zone of influence is, generally, considered sufficient to provide an indication of the baseline community. This is because a long-term data set is available for one site, however, additional surveys are required at selected sites to provide a robust baseline.

Following completion of the Gate 1 assessment, targeted surveys were completed for the length of the River Lee and also at key locations downstream on behalf of the London Effluent Reuse SRO (see Section 6.2 for details of sites).

Baseline LIFE data indicates that under present conditions, the invertebrate community in the impacted reaches are not sensitive to reduced flows (Figure 2-5). See Table 2-1 for guidance in interpreting raw LIFE scores.

WHPT and PSI EQR scores (Table 2-9) are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for WHPT_{NTAXA} and WHPT_{ASPT}, see Figure 2-5.

Data from the monitoring sites show variation in WHPT_{ASPT} scores over the period 2000 to 2021 are consistent for the standard to achieve poor or bad WFD status over the monitoring period. WHPT_{ASPT} scores (Table 2-9) from the sites identifies invertebrate communities which are composed of an average proportion of taxa which are not sensitive to pressures. There are no instances of deterioration to this standard during the monitoring period as such the community is not expected to have been impaired by water quality pressures historically.

The baseline data (Table 2-9) suggest that the invertebrate community within the reach from the Chingford abstractions to Three Mills Lock is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slow flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). This is also represented by the Ecological Quality Ratios (EQRs) for the London Effluent Reuse SRO monitoring locations which are indicative of poor ecological status (i.e., the community composition and abundances are worse than expected based on the baseline physical environment characteristics).

The PSI scores (Table 2-9) suggest that the available habitat was either 'moderately sedimented' or 'heavily sedimented', which is typical for a large lowland depositing river such as the River Lee.

Other invertebrates of interest were recorded in the River Lee between Chingford Abstractions to Three Mills Lock. This included the *Musculium lacustre* which is considered threatened in Ireland by agricultural drainage and the physical destruction of habitats, though is considered of 'least concern' in the UK³⁰. Details on protected species can be found in Section 2.9.

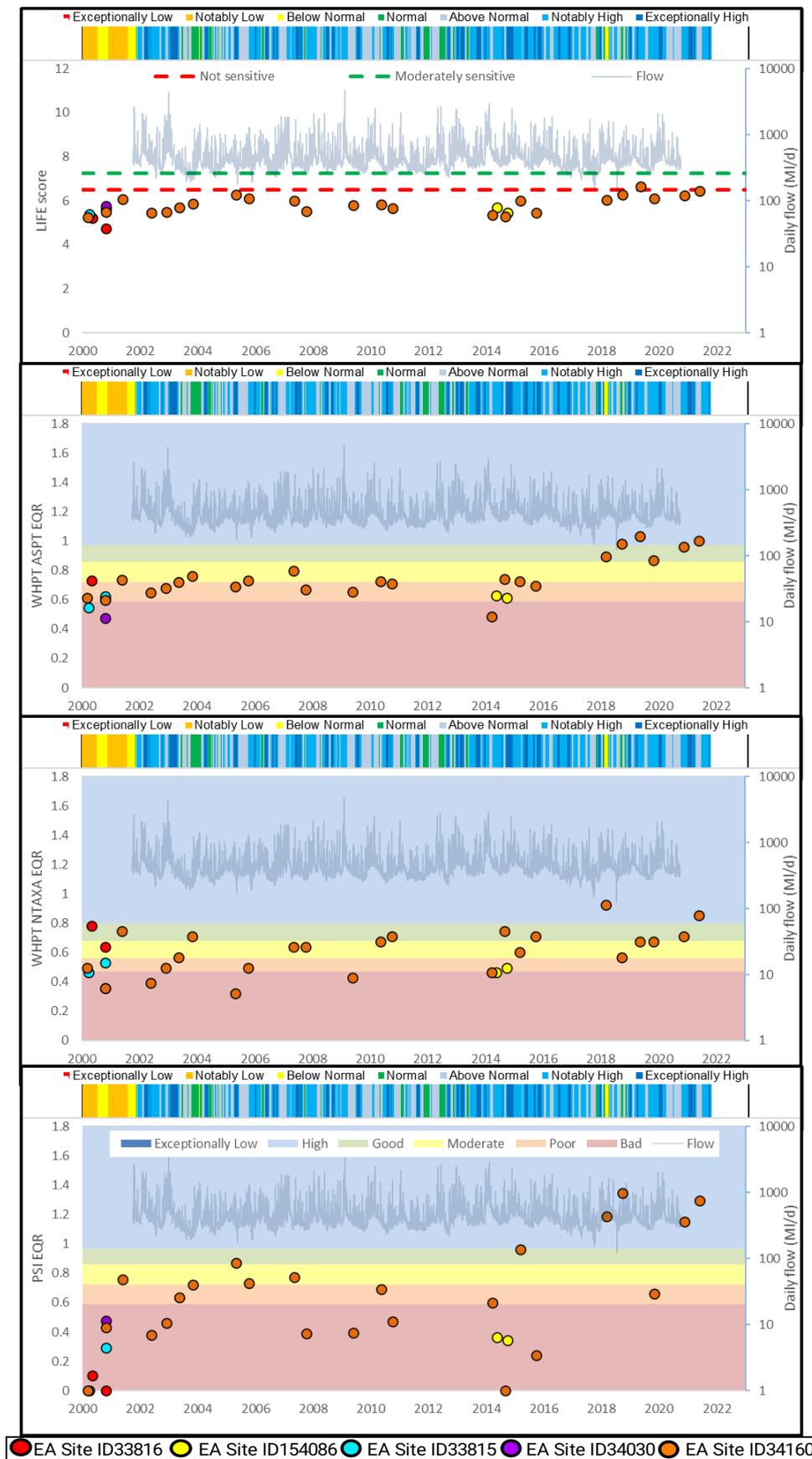
²⁹ <https://environment.data.gov.uk/catchment-planning>

³⁰ Seddon, M.B., Killeen, I., Madhyastha, A. & Mackie, G. 2017. *Musculium lacustre*. The IUCN Red List of Threatened Species 2017: e.T155915A69490644. <https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T155915A69490644.en>. Accessed on 08 September 2022.

Table 2-9 Biological indices for monitoring sites in Reach H

Site Order	1	2	3	4	5
SITE_ID	EA Site ID33816	EA Site ID154086	EA Site ID33815	EA Site ID34030	EA Site ID34160
Survey count	2	2	2	1	24
Min survey year	08/05/2000	13/05/2014	30/03/2000	26/10/2000	09/03/2000
Max survey year	26/10/2000	24/09/2014	24/10/2000	26/10/2000	26/05/2021
LIFE SCORE MAX	0.847482	0.927187	0.914174	0.935321	1.081719
LIFE SCORE MAX class	Poor	Moderate	Moderate	Moderate	High
LIFE SCORE MIN	0.769403	0.886521	0.878388	0.935321	0.853988
LIFE SCORE MIN class	Bad	Moderate	Poor	Moderate	Poor
LIFE SCORE MEAN	0.808442	0.906854	0.896281	0.935321	0.951858
LIFE SCORE MEAN class	Bad	Moderate	Moderate	Moderate	Good
WHPT _{ASPT} EQR MAX	0.732577	0.631075	0.622249	0.47441	1.032669
WHPT _{ASPT} EQR MAX class	Moderate	Poor	Poor	Bad	High
WHPT _{ASPT} EQR MIN	0.60239	0.615629	0.547226	0.47441	0.487649
WHPT _{ASPT} EQR MIN class	Poor	Poor	Poor	Bad	Bad
WHPT _{ASPT} EQR MEAN	0.667484	0.623352	0.584738	0.47441	0.755102
WHPT _{ASPT} EQR MEAN class	Poor	Poor	Poor	Bad	Moderate
HPT _{NTAXA} EQR MAX	0.783074	0.49832	0.533914	0.355943	0.925451
HPT _{NTAXA} EQR MAX class	Good	Poor	Poor	Bad	High
HPT _{NTAXA} EQR MIN	0.640697	0.462726	0.462726	0.355943	0.320349
HPT _{NTAXA} EQR MIN class	Moderate	Bad	Bad	Bad	Bad
HPT _{NTAXA} EQR MEAN	0.711886	0.480523	0.49832	0.355943	0.609552
WHPT _{NTAXA} EQR MEAN class	Good	Poor	Poor	Bad	Moderate
PSI MAX	0.100855	0.36634	0.290699	0.824142	2.035883
PSI MAX class	Bad	Bad	Bad	High	High
PSI MIN		0.341127		0.824142	
PSI MIN class		Bad		High	
PSI MEAN	0.050427	0.353733	0.14535	0.824142	0.716428
PSI MEAN class	Bad	Bad	Bad	High	Good

Figure 2-5 Aquatic invertebrate baseline data for Reach H 2000-2022. In order: LIFE, WHPT_{ASPT}, WHPT_{NTAXA} and PSI



2.4 AQUATIC INVERTEBRATES ESTUARINE

2.4.1 Overview

This section sets out the reference conditions for the estuarine invertebrates:

- Estuarine Thames Tideway - Section 2.4.2
- Estuarine River Lee – Section 2.4.3

The evidence available, the general patterns observed in the data and any notable pressures are outlined for each of these reaches in the following sections.

2.4.2 Estuarine Thames Tideway

Reach D – Teddington Weir to Battersea Park

The WFD water body GB530603911403 Thames is not classified for invertebrates in 2019 under Cycle 2³¹.

The EA has collected invertebrate data at eight locations within Reach D on the estuarine Thames Tideway between 2006 and 2021 (Table 2-10). For Reach D these sites are LRUS – 011, LRUS – 012, EA Site ID98148, LRUS – 013, EA Site ID98141, LRUS – 014, LRUS – 015, EA, Site ID98145.

The available invertebrate data within the zone of influence is, generally, considered sufficient to provide an indication of the baseline community. It should be noted that Reach D of the Thames Tideway is considered to be freshwater and the application of the WFD Transitional and Coastal (TraC) benthic invertebrate Infaunal Quality Index (IQI) at salinities less than 20‰ should be treated with caution³². Furthermore, at salinities less than 1‰ the use of the IQI and the interpretation of the WFD classification becomes problematic³³. As such, Reach D of the Thames has been assessed using freshwater invertebrate biological indices and metrics.

Following completion of the Gate 1 assessment, targeted surveys were completed for the length of the River Lee and also at key locations downstream on behalf of the London Effluent Reuse SRO (see Section 6.2 for details of sites). Baseline LIFE data indicates that under present conditions, the invertebrate community in the impacted reaches are not sensitive to reduced flows (Figure 2-6). See Table 2-1 for guidance in interpreting raw LIFE scores.

WHPT and PSI EQR scores (Table 2-10) are calculated based on available environmental parameters provided by the Environment Agency's online Ecology & Fish Data Explorer. Data which comprises of spring and autumn sampling occasions for a given year generate WFD classifications, these EQR's are displayed for WHPT_{NTAXA} and WHPT_{ASPT}, see Figure 2-6.

Data from the monitoring site shows variation in WHPT_{ASPT} scores over the period 2006 to 2021 are consistent for the standard to achieve moderate WFD status over the monitoring period. WHPT_{ASPT} scores from the site identifies invertebrate communities which are composed of a low proportion of taxa which are not sensitive to pressures. There are no instances of deterioration to this standard during the monitoring period as such the community is not expected to have been impaired by water quality pressures historically.

The baseline data suggest that the invertebrate community within the reach from the Teddington Weir to Battersea Park is not sensitive to water quality and flow changes. It is noted that the communities generally have a preference for slow flowing water and are dominated by taxa with a high tolerance for pollution (i.e., not sensitive to water quality changes). This is also represented by the Ecological Quality Ratios (EQRs) for the London Effluent Reuse SRO monitoring locations which are indicative of bad or moderate ecological status (i.e., the community composition and abundances are worse than expected based on the baseline physical environment characteristics).

The PSI scores suggest that the available habitat was 'heavily sedimented', which is typical for a large lowland depositing river such as the Thames Tideway.

No other invertebrates of interest were recorded in the estuarine Thames Tideway Teddington Weir to Battersea Park. Details on protected species can be found in Section 2.9.

³¹ <https://environment.data.gov.uk/catchment-planning>

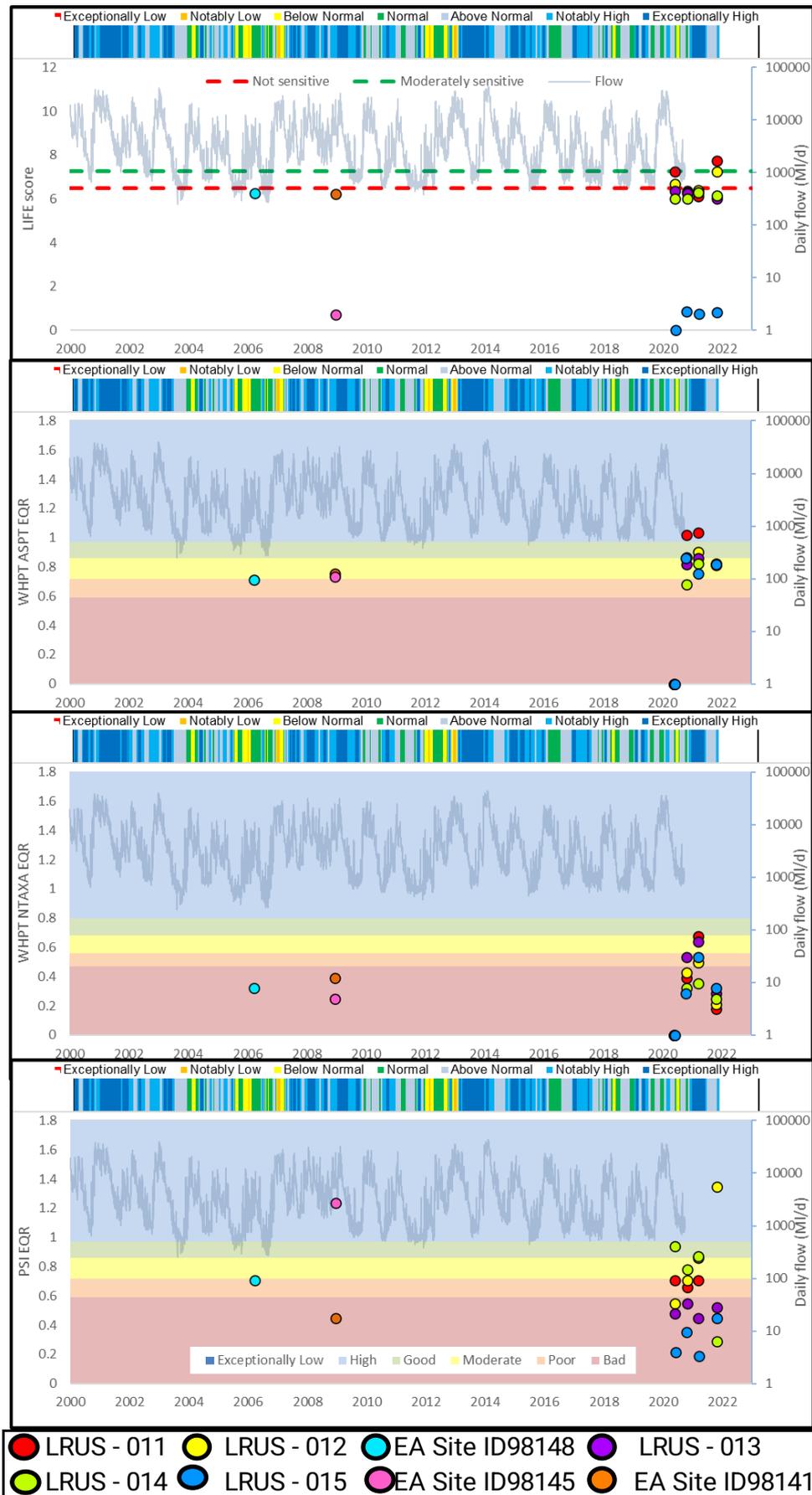
³² UKTAG (2014). UKTAG Transitional and Coastal Water Assessment Method Benthic Invertebrate Fauna Infaunal Quality Index.

³³ Graham Phillips, Environment Agency, Pers.Comm.

Table 2-10 Biological indices for monitoring sites in Reach D

Site Order	1	2	3	4	5	6	7	8
SITE_ID	LRUS - 011	LRUS - 012	EA Site ID98148	LRUS - 013	EA Site ID98141	LRUS - 014	LRUS - 015	EA Site ID98145
Survey count	4	4	1	4	1	4	4	1
Min survey year	27/10/2021	27/10/2021	20/03/2006	27/10/2021	15/12/2008	27/10/2021	27/10/2021	15/12/2008
Max survey year	27/05/2020	27/05/2020	20/03/2006	27/05/2020	15/12/2008	27/05/2020	02/06/2020	15/12/2008
LIFE SCORE MAX	1.26065	1.179317	1.016653	1.037799	1.011773	1.023159	1.078465	1.106118
LIFE SCORE MAX class	High	High	High	High	High	High	High	High
LIFE SCORE MIN	0.995507	1.024786	1.016653	0.975987	1.011773	0.975987	0.962974	1.106118
LIFE SCORE MIN class	High	High	High	High	High	High	Good	High
LIFE SCORE MEAN	1.118318	1.082532	1.016653	1.013806	1.011773	0.994558	1.022753	1.106118
LIFE SCORE MEAN class	High	High	High	High	High	High	High	High
WHPT _{ASPT} EQR MAX	1.035921	0.901536	0.710511	0.863009	0.754643	0.823046	0.860557	0.734784
WHPT _{ASPT} EQR MAX class	High	Good	Poor	Moderate	Moderate	Moderate	Moderate	Moderate
WHPT _{ASPT} EQR MIN	0	0	0.710511	0	0.754643	0	0	0.734784
WHPT _{ASPT} EQR MIN class	0	0	Poor	0	Moderate	0	0	Moderate
WHPT _{ASPT} EQR MEAN	0.71674	0.647388	0.710511	0.624333	0.754643	0.580438	0.608887	0.734784
WHPT _{ASPT} EQR MEAN class	Poor	Poor	Poor	Poor	Moderate	Poor	Poor	Moderate
WHPT _{NTAXA} EQR MAX	0.676291	0.49832	0.320349	0.640697	0.391537	0.355943	0.533914	0.24916
WHPT _{NTAXA} EQR MAX class	Moderate	Poor	Bad	Moderate	Bad	Bad	Poor	Bad
WHPT _{NTAXA} EQR MIN	0	0	0.320349	0	0.391537	0	0	0.24916
WHPT _{NTAXA} EQR MIN class	0	0	Bad	0	Bad	0	0	Bad
WHPT _{NTAXA} EQR MEAN	0.31145	0.284754	0.320349	0.364841	0.391537	0.231363	0.284754	0.24916
WHPT _{NTAXA} EQR MEAN class	Bad	Bad	Bad	Bad	Bad	Bad	Bad	Bad
PSI MAX	2.746591	1.348326	0.706478	0.548769	0.449397	0.941806	0.449442	1.235966
PSI MAX class	High	High	Good	Poor	Bad	High	Bad	High
PSI MIN	0.657534	0.549263	0.706478	0.449397	0.449397	0.290815	0.190149	1.235966
PSI MIN class	Moderate	poor	good	Bad	Bad	Bad	Bad	High
PSI MEAN	1.20427	0.865951	0.706478	0.499285	0.449397	0.721462	0.30191	1.235966

Figure 2-6 Aquatic invertebrate baseline data for Reach D 2000-2022. In order: LIFE, WHPT_{ASPT}, WHPT_{NTAXA} and PSI



Reach E – Battersea Park to Tower Bridge

There are no invertebrate samples within this reach and therefore no baseline assessment.

Reach F - Tower Bridge to 3km seawards of Beckton STW

There are no invertebrate samples within this reach and therefore no baseline assessment.

2.4.3 Estuarine River Lee

Reach I - Estuarine Bow Creek (tidal Lee) Reach I: Three Mills Lock to Thames Tideway

There are no invertebrate samples within this reach and therefore no baseline assessment.

2.5 MARGINAL HABITAT ASSESSMENT

2.5.1 Overview

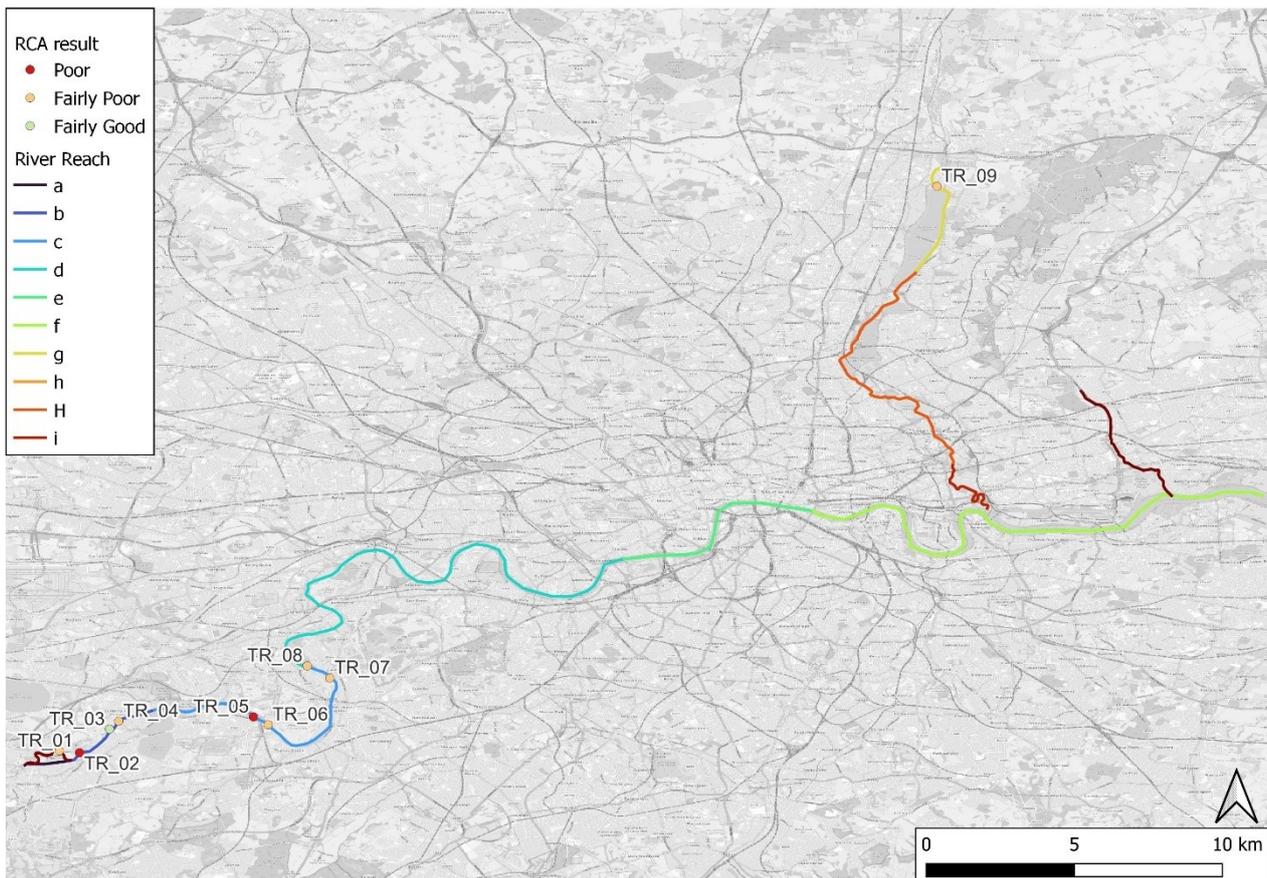
This section sets out the reference conditions for the marginal habitat assessment:

- Freshwater River Thames - Section 2.5.2
- Freshwater Lee Diversion Channel – Section 2.5.3

The evidence available, the general patterns observed in the data and any notable pressures are outlined for each of these reaches in the following sections.

Details of the survey results are shown in the River Condition Assessment Baseline Survey Results report (Jacobs, 2022)³⁴. A total of eight RCAs were associated with the River Thames (TR_01 to TR_08) and one RCA was associated with the River Lee (TR_09), these are shown on Figure 2-7. Each MoRPh survey provides a preliminary condition score, which is combined with an assessment of the river type to give a final condition score. A river type is a defined group of river channels displaying similar planform, bed material and morphological features and dynamics reflecting the flow and sediment transfer processes to which it is subject to. For a breakdown of each river’s assessed field characteristics, see Table 4.3 in the River Condition Assessment Baseline Survey Results report³⁵.

Figure 2-7 River Condition Assessment results



2.5.2 Freshwater River Thames

There are six defined reaches of the freshwater River Thames; reaches A to F. RCAs were undertaken on reaches A, B and C and the headline results are detailed below.

³⁴ Jacobs. (2022). London Effluent Reuse SRO. River Condition Assessment Baseline Survey Results. B22849BM 2.

³⁵ Jacobs. (2022). London Effluent Reuse SRO. River Condition Assessment Baseline Survey Results. B22849BM 2.

Reach A – Shepperton Weir to Affinity Water Walton Intake

One RCA is associated with Reach A; TR_01. The result of the assessment found this section of the River Thames to be 'Large' type and in Fairly Poor condition. Large rivers are those that are too wide or deep for reliable bed material information to be collected during a MoRPh field survey.

Reach B – Affinity Water Walton Intake to Thames Water Walton Intake

Three RCAs are associated with Reach B; TR_02, TR_03 and TR_04. Site TR_03 is within Sunbury Creek and not the main channel. The results of the assessment are:

- TR_02: 'Large' type and Poor condition
- TR_03 (Sunbury Creek): 'H' type and Fairly Good condition
- TR_04: 'Large' type and Fairly Poor condition

'H' type rivers are those which typically have a straight/sinuuous planform, sand dominated substrate with gravel/cobble and are unconfined or partially confined in their valley.

Reach C – Thames Water Walton Intake to Teddington Weir

Four RCAs are associated with Reach C; TR_05, TR_06, TR_07 and TR_08. The results of the assessment are:

- TR_05: 'Large' type and Poor condition
- TR_06: 'Large' type and Fairly Poor condition
- TR_07: 'K' type and Fairly Poor condition
- TR_08: 'Large' type and Fairly Poor condition

'K' type rivers are those which typically have a straight/sinuuous planform, silt/clay dominated substrate with sand/gravel and are unconfined or partially confined in their valley. TR_07 differs from the others in Reach C as it is a smaller side channel of the main River Thames which branches off at the southern end of Trowlock Island and rejoins the main channel approximately 530m downstream.

2.5.3 Freshwater Lee Diversion Channel

There are three defined reaches of the Lee Diversion Channel, Reaches G, H and I. RCAs were undertaken on Reach G.

Reach G - Newmans Weir on the Enfield Island Loop to Chingford Abstractions

One RCA is associated with reach G; TR_09. The result of the assessment found this section of the River Lee to be 'H' type and in Fairly Poor condition.

2.6 MACROPHYTES

2.6.1 Overview

This section sets out the reference conditions for the macrophytes assessment:

- Freshwater River Thames – Section 2.6.2
- Freshwater Lee Diversion Channel – Section 2.6.3

The evidence available, the general patterns observed in the data and any notable pressures are outlined for each of these reaches in the following sections.

Macrophyte assessments were conducted using the Environment Agency’s Ecology and Fish Data Explorer using data from 2010 to 2022. In addition, supplementary data from the baseline monitoring conducted by London Effluent Reuse SRO monitoring programme was used (Table 2-11). Additional data from surveys conducted in 2021 is available but not yet included in this iteration of the Aquatic Ecology Report.

Table 2-11 Summary of Macrophyte EQR scores

Reach	Location	Number of sites	Mean EQR	EQR Classification
G	Chingford Abstractions to Three Mills Lock	9	0.345	Poor
H	EIL to Chingford Abstractions	2	0.274	Poor
A	Shepperton Lock to Affinity Water Walton Intake	4	0.753	Good
B	Affinity Water Walton Intake to Thames Water Walton Intake	1	0.441	Moderate
C	Thames Water Walton Intake to Teddington Weir	9	0.445	Moderate

2.6.2 Freshwater River Thames

Reach A – Shepperton Weir to Affinity Water Walton Intake

The EA has collected macrophyte data at two locations within Reach A on the freshwater River Thames between 2010 and 2019 (Table 2-12), comprising of four surveys.

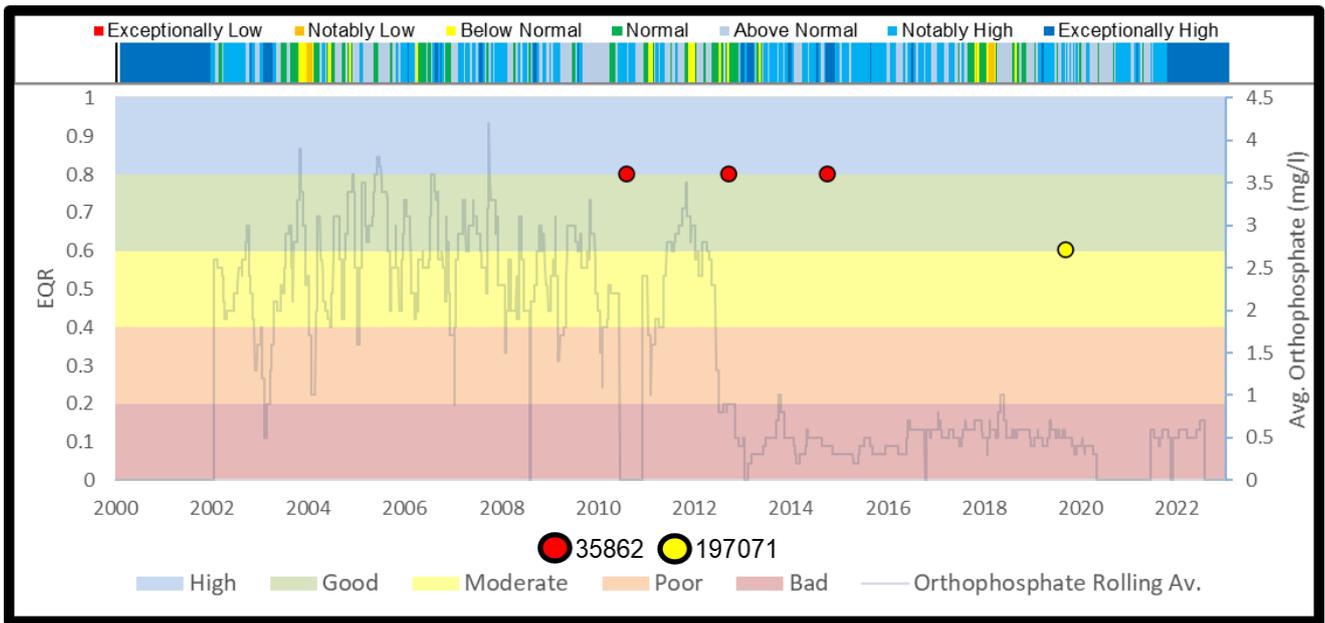
Table 2-12 Macrophyte monitoring sites and calculated scores for Reach A for 2010 to 2022

Site ID	Location	Survey count	Survey range	RMNI MEAN	RN_A_TA XA Mean	N_RFG MEAN	RFA_PC MEAN	EQR	EQR CLASS
197071	TQ0848566040	1	09/09/2019	6.3	5	4	0.05	0.605	Good
35862	SU9987875784	3	06/08/2010 to 30/09/2014	7.76	16.67	11.3	6.22	0.802	High

Baseline data indicates that within this reach, the biological status of the macrophyte community is considered Good to High, based on the calculated EQR values (Figure 2-8, Table 2-12). This suggests that the macrophyte community within this reach is in an unimpacted or natural state.

The mean RMNI scores suggests that the community within this reach is associated with slightly higher nutrient enriched rivers. Site 35862 had significantly higher number of algal taxa present, along with larger amounts of functional macrophyte groups, and a higher cover of green filamentous algae. Filamentous algae cover was particularly low for site 197071 at only 0.05 (Table 2-12).

Figure 2-8 Macrophyte baseline data for Reach A - 2010 to 2022 - EQR Values



Reach B – Affinity Water Walton Intake to Thames Water Walton Intake

The EA has collected macrophyte data at a single location within Reach B on the freshwater River Thames between 2010 and 2022 (Table 2-13). This site was repeated by London Effluent Reuse SRO monitoring programme in 2020 as per the Thames Water SRO Macrophyte report London Reuse.

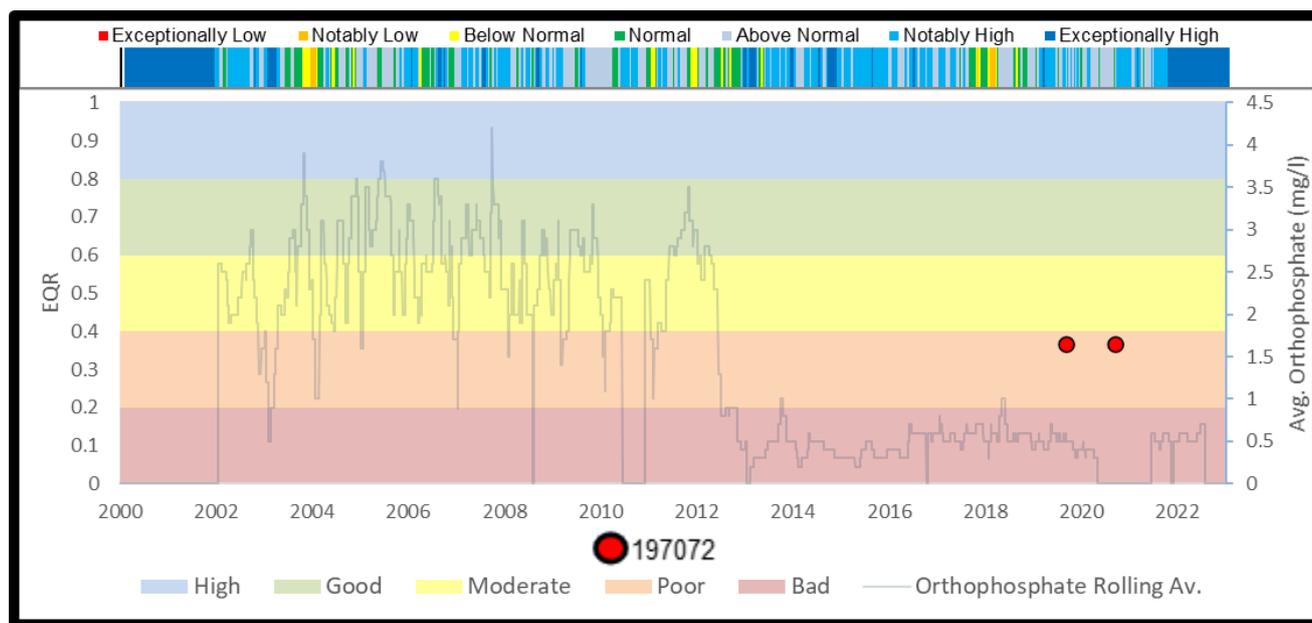
Baseline data indicates that within Reach B, the biological status of the macrophyte community is considered poor, based on the calculated EQR values (Figure 2-9). This suggests that the macrophyte community within this reach is in an impacted state.

The mean RMNI scores suggests that the community within this reach is associated with higher nutrient enriched rivers. Site 197072 had a particularly low cover of green filamentous algae (Table 2-13).

Table 2-13 Macrophyte monitoring sites and calculated scores for Reach B for 2010 to 2022

Site ID	Location	Survey count	Survey range	RMNI MEAN	RN_A_TA XA Mean	N_RFG MEAN	RFA_PC MEAN	EQR	EQR CLASS
197072	TQ0922266429	2	09/09/2019 to 17/09/2020	7.35	6	6	0.5	0.441	Poor

Figure 2-9 Macrophyte baseline data for Reach B - 2010 to 2022 - EQR Values



Reach C – Thames Water Walton Intake to Teddington Weir

The EA has collected macrophyte data at two locations within Reach C on the River Thames between 2010 and 2022 (Table 2-14), comprising of six individual surveys. A further five surveys at five locations were completed in 2020 by London Effluent Reuse SRO monitoring programme as per the Thames Water SRO Macrophyte report London Reuse.

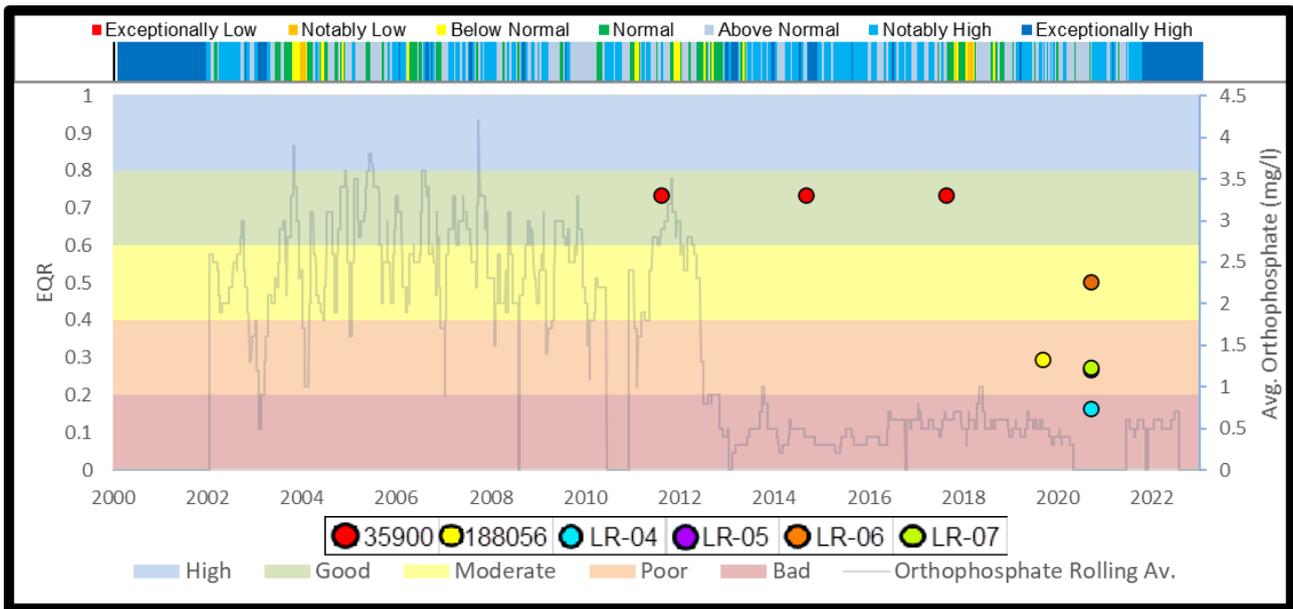
Baseline data indicates that within this reach, the biological status of the macrophyte community ranges from Poor to Good, based on the calculated EQR values (Figure 2-10). Five of the seven sites contain a macrophyte community with biological status of Poor or Bad, which suggests that large sections of the reach contain macrophyte communities that are highly degraded.

The mean RMNI scores suggests that the community within this reach is associated with higher nutrient enriched rivers. All sites had a similar number of Algal taxa present, along with similar amounts of functional macrophyte groups. Most of the sites had a very low cover of green filamentous algae, apart from site 355900 which had a green filamentous algal cover of 12.85 (Table 2-14).

Table 2-14 Macrophyte monitoring sites and calculated scores for Reach C for 2010 to 2022

Site ID	Location	Survey count	Survey range	RMNI MEAN	RN_A_TA XA Mean	N_RFG MEAN	RFA_PC MEAN	EQR	EQR CLASS
35900	TQ1744067824	3	28/08/2007 to 17/08/2017	7.81	7.81	8.7	12.85	0.735	Good
188056	TQ1741471171	1	09/09/2019	7.61	7.61	8	0.5	0.296	Poor
LR-04	TQ1323969117	1	17/09/2020	8.53	10	7	1.75	0.165	Bad
LR-05	TQ1471069168	1	17/09/2020	8.08	7	5	0.05	0.270	Poor
LR-06	TQ1761368092	1	17/09/2020	6.89	5	4	0.5	0.502	Moderate
LR-07	TQ1743971207	1	17/09/2020	8.06	8	6	0.05	0.275	Poor

Figure 2-10 Macrophyte baseline data for Reach C - 2010 to 2022 - EQR Values



2.6.3 Freshwater Lee Diversion Channel

Reach G – Newmans Weir on the Enfield Island Loop to Chingford Abstractions

There was no EA Macrophyte data available within Reach G on the River Lee between 2010 and 2022. Two surveys at two locations were completed in 2020 by the London Effluent Reuse SRO monitoring programme as per the Thames Water SRO Macrophyte report London Reuse (Table 2-15).

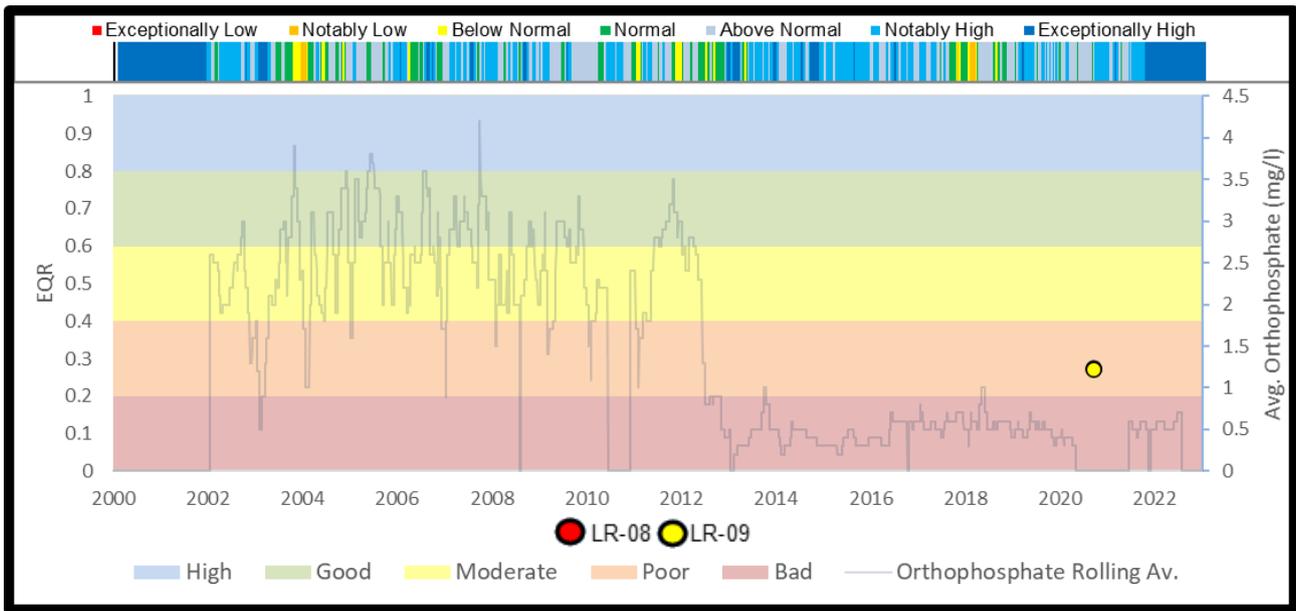
Baseline data indicates that within this reach, the biological status of the macrophyte community is poor, based on the calculated EQR values (Figure 2-11, Table 2-15). This suggests that the macrophyte community within this reach is likely to be in a highly degraded state.

The mean RMNI scores suggests that the community within this reach is associated with higher nutrient enriched rivers, though orthophosphate concentrations have decreased since 2013 possibly indicating a lack of recovery or the presence of other stressors. Both sites had a similar number of Algal taxa present, along with similar amounts of functional macrophyte groups, along with the sites had a very low cover of green filamentous algae (Table 2-15).

Table 2-15 Macrophyte monitoring sites and calculated scores for Reach G for 2010 to 2022

SITE_ID	Location	Survey count	Survey range	RMNI MEAN	RN_A_TA XA Mean	N_RFG MEAN	RFA_PC MEAN	EQR	EQR CLASS
LR-08	TQ3727898177	1	17/09/2020	8.06	10	8	0.05	0.275	Poor
LR-09	TQ3754397894	1	17/09/2020	8.07	10	8	0.05	0.273	Poor

Figure 2-11 Calculated EQR scores of Macrophyte baseline data for Reach G for 2010 to 2022



Reach H – Chingford Abstractions to Three Mills Lock

There were eight surveys conducted by the EA within Reach H between 2010 and 2022, split across two sites on the River Lee (Table 2-16). Site 34160 was then repeated by the London Effluent Reuse SRO monitoring programme once in 2020.

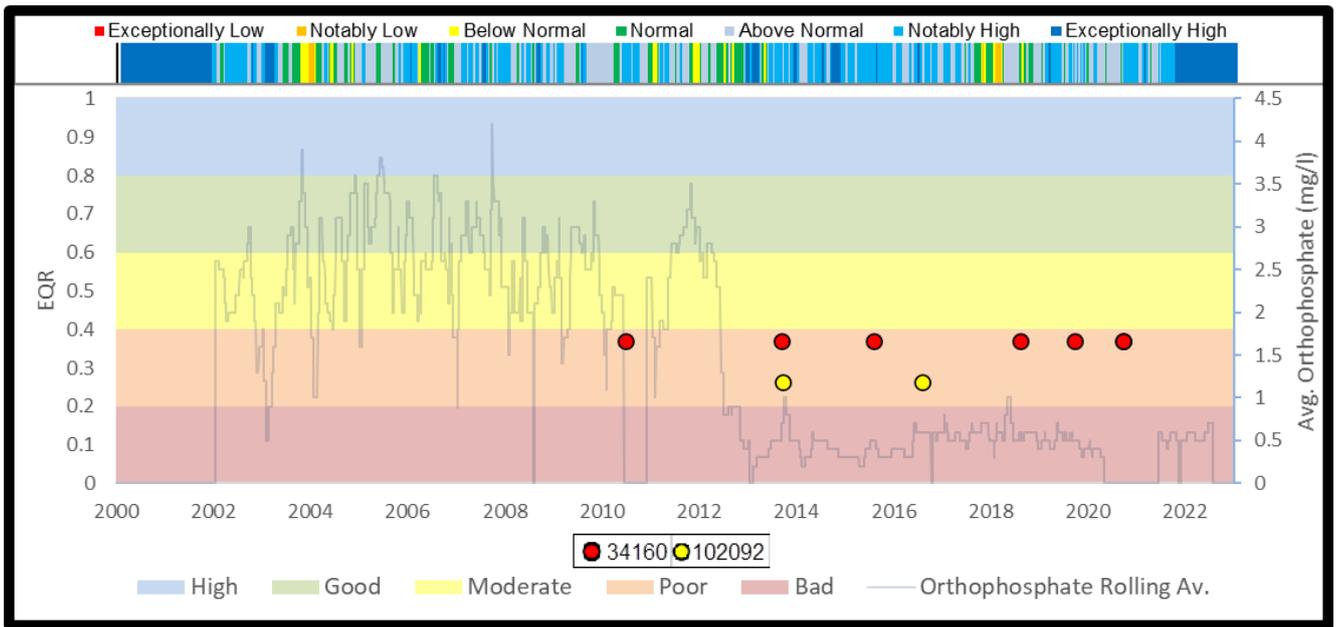
Baseline data indicates that within this reach, the biological status of the macrophyte community is rated from as Poor, based on the calculated EQR values (Figure 2-12, Table 2-16). This suggests that the macrophyte community within this reach is in a highly degraded state.

The mean RMNI scores suggests that the community within this reach is associated with highly nutrient enriched rivers, though orthophosphate concentrations have decreased since 2013 possibly indicating a lack of recovery or the presence of other stressors. Site 102092 had much lower algal taxa present than the other site, and site 34160 had a much higher percentage cover of green filamentous algae (Table 2-16).

Table 2-16 Calculated EQR scores of Macrophyte baseline data for Reach H for 2010 to 2022

SITE_ID	Location	Survey count	Survey range	RMNI MEAN	RN_A_TA XA Mean	N_RFG MEAN	RFA_PC MEAN	EQR	EQR CLASS
34160	TQ3651586502	6	01/07/2010 to 19/09/2020	8.68	10	6.5	12.96	0.382	Poor
102092	TQ3588692538	2	18/09/2013 to 02/08/2016	8.935	4	3	0.28	0.263	Poor

Figure 2-12 Calculated EQR scores of Macrophyte baseline data for Reach H for 2010 to 2022



2.7 DIATOMS

2.7.1 Overview

This section sets out the reference conditions for the macrophytes assessment:

- Freshwater River Thames - Section 2.7.2
- Estuarine Thames Tideway – Section 2.7.3
- Freshwater Lee Diversion Channel – Section 2.7.4

The evidence available, the general patterns observed in the data and any notable pressures are outlined for each of these reaches in the following sections.

2.7.2 Freshwater River Thames

Reach A – Shepperton Weir to Affinity Water Walton Intake

Reach A is within the WFD water body GB106039023232 (Thames (Egham to Teddington)) is classified as ‘poor’ for Macrophytes and Phytobenthos Combined in 2019 under Cycle 2³⁶. Baseline diatom data was provided by the London Effluent Reuse SRO monitoring programme for two sites in the freshwater River Thames (ID LRUS - 010 and LRUS – 001), with both surveyed twice in 2021 (Table 2-17).

Table 2-17 Diatom monitoring in Reach A

Site ID	NGR	Survey count	Survey range	Max – Min (Avg.)				
				TDI4 % Motile	TDI4 % PTV	TDI4 % Salinity	TDI4 score	TDI4 EQR
LRUS - 010	TQ0781765991	2	27/10/2021 to 26/04/2022	19.11 - 9.91 (14.51)	10.99 - 7.33 (9.16)	0.26 – 0 (0.13)	59.85 - 48.0 (53.92)	0.88 - 0.71 (0.80)
LRUS - 001	TQ0848566040	2	25/10/2021 to 26/04/2022	22.86 - 13.97 (18.41)	7.86 - 4.77 (6.31)	0.75 – 0 (0.37)	88.81 - 68.5 (78.66)	0.53 - 0.21 (0.37)

The available diatom data within the zone of influence is, generally, not considered sufficient to provide an indication of the baseline community. This is because a long-term data set is not available for this site. Therefore, additional and more up to date surveys are required to understand current levels and give a larger, more robust dataset to understand baseline conditions further.

Following completion of the Gate 1 assessment, targeted diatom surveys were completed for the length of the freshwater River Thames and also at key locations downstream on by the London Effluent Reuse SRO monitoring programme.

The percentage of the motile diatoms across the sites also recorded low scores, with the spring surveys recording lower scores than the autumn surveys. The fact that these scores are generally low suggests that the environment is typically stable and that the majority of diatoms within the reach will be affected by changing flow conditions if subjected to them.

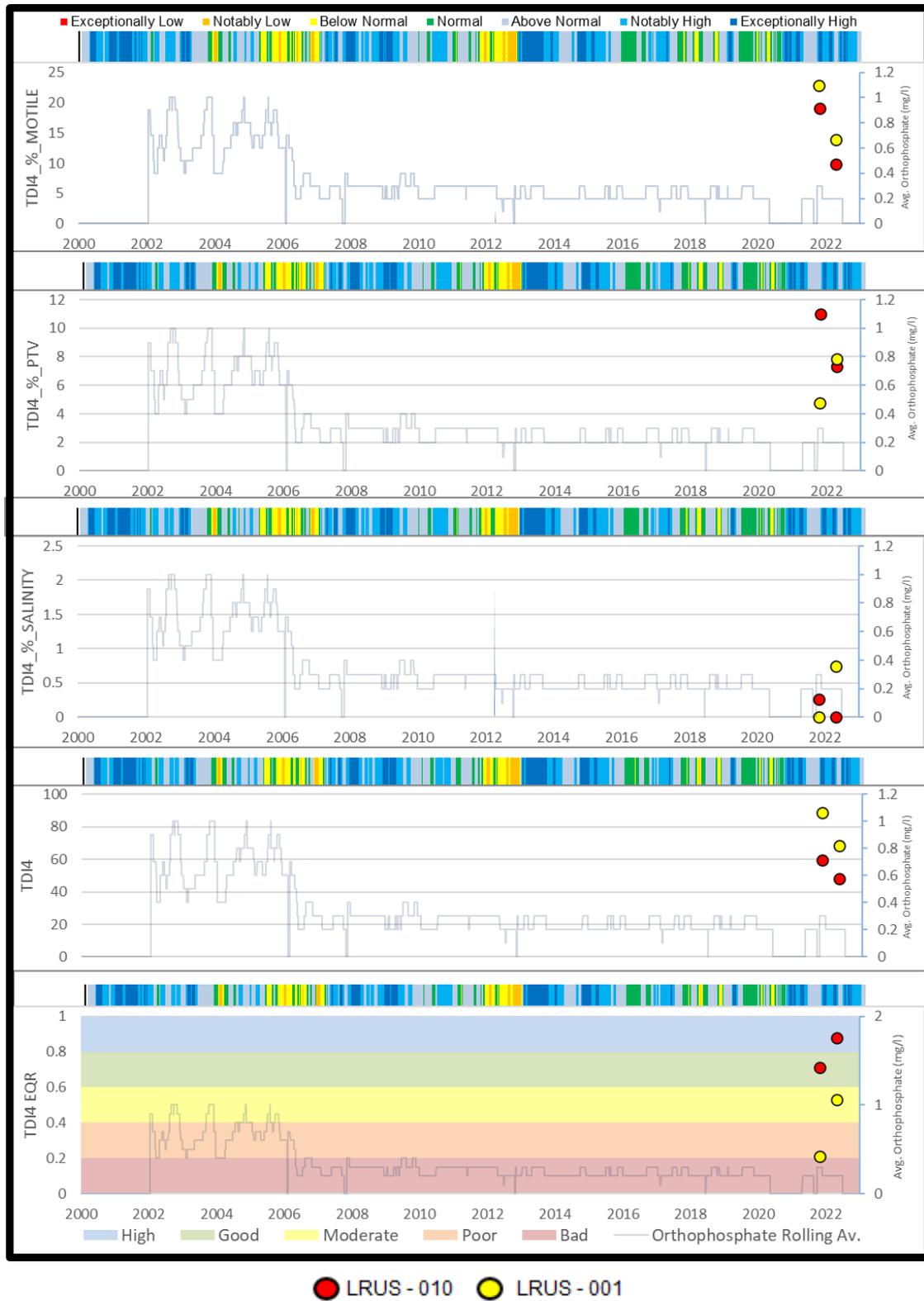
Percentage PTV scores across all sites show the diatoms in this reach have a low tolerance to organic pollution. Therefore, any extra organic input into this reach will have an effect on the diatom communities currently present.

Baseline diatom data provided by the London Effluent Reuse SRO monitoring programme show that TDI4 scores suggest that there is no organic pollution at the site (Figure 2-13). Overall EQR scores were calculated

³⁶ <https://environment.data.gov.uk/catchment-planning>

for each sample based on predicted TDI4 for observed alkalinity and season. Samples taken from site LRUS -010 showed EQR scores of 'good' and 'high' over the two sample dates. In comparison, site LRUS-001 scores were lower, being classified as 'poor' and 'moderate'. See Table 2-2 above (Section 2.2) for guidance in interpreting TDI4 EQR scores.

Figure 2-13 Diatom baseline data for Reach A



Reach B – Affinity Water Walton Intake to Thames Water Walton Intake

Reach B is within the WFD water body GB106039023232 (Thames (Egham to Teddington)) is classified as ‘poor’ for Macrophytes and Phytobenthos Combined in 2019 under Cycle 2³⁷. Baseline diatom data was provided by the London Effluent Reuse SRO monitoring programme for two sites in the freshwater River Thames (ID LRUS - 002 and LRUS – 003), with both surveyed twice in 2021 (Table 2-18).

Table 2-18 - Diatom monitoring in Reach B

Site ID	NGR	Survey count	Survey range	Max – Min (Avg.)				
				TDI4 % Motile	TDI4 % PTV	TDI4 % Salinity	TDI4 score	TDI4 EQR
LRUS - 002	TQ0977066798	2	25/10/2021 to 26/04/2022	59.75 - 27.15 (43.45)	32.7 - 11.22 (21.96)	29.25 - 0.55 (14.90)	79.5 - 69.3 (74.4)	0.65 - 0.34 (0.5)
LRUS - 003	TQ1141168761	2	26/10/2021 to 25/04/2022	17.36 - 6.84 (12.1)	6.61 - 2.85 (4.73)	2.3 - 1.14 (1.72)	74.0 - 70.2 (72.1)	0.63 - 0.56 (0.6)

The available diatom data within the zone of influence is not considered sufficient to provide an indication of the baseline community. This is because a long-term data set is not available for this site. Therefore, additional and more up to date surveys are required to understand current levels and give a larger, more robust dataset to understand baseline conditions further.

Following completion of the Gate 1 assessment, targeted diatom surveys were completed for the length of the River Thames and also at key locations downstream on behalf of the London Effluent Reuse SRO monitoring programme.

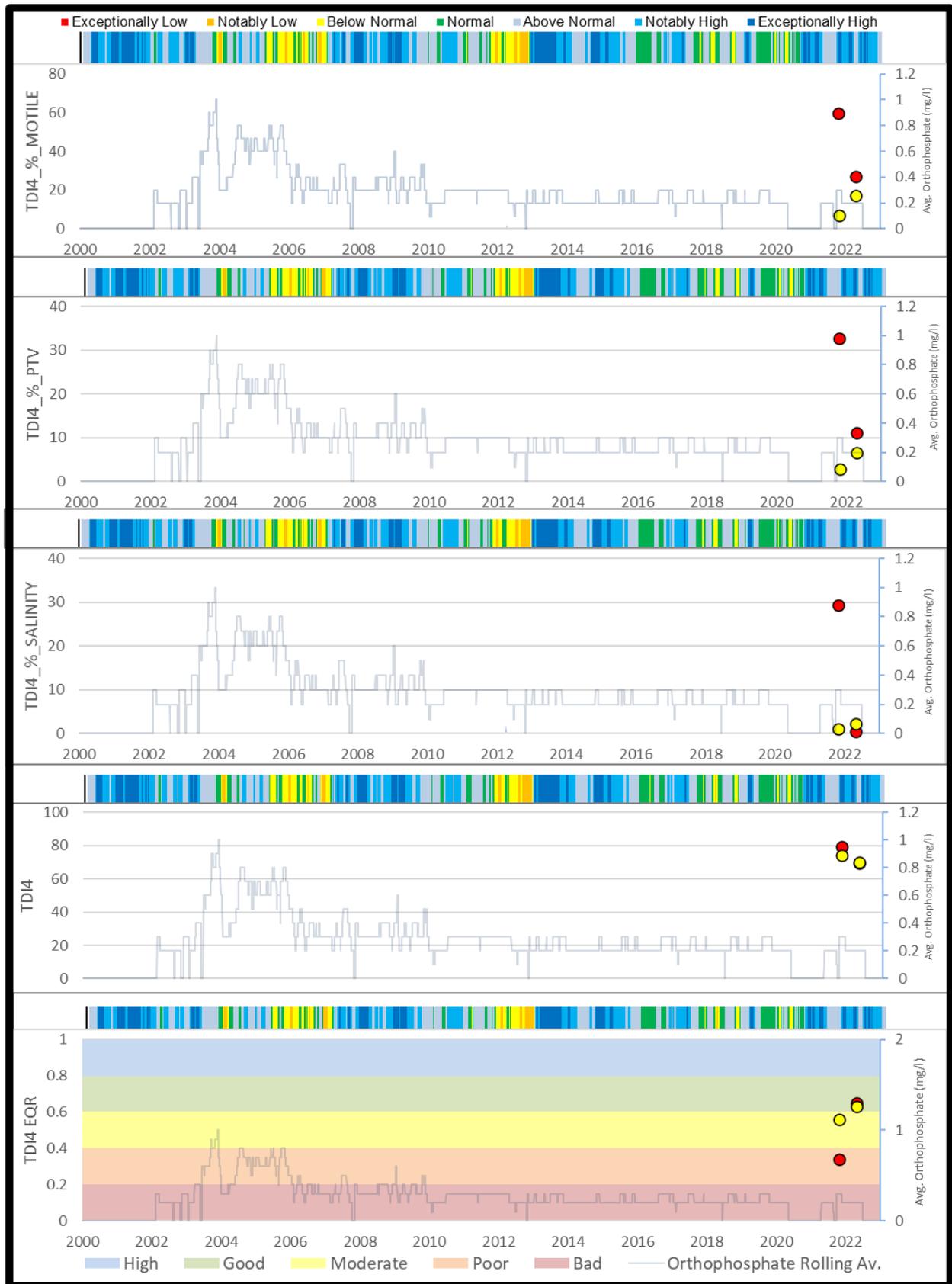
The percentage of the motile diatoms varied between the sites, with LRUS-002 having a higher percentage than LRUS-003. Having varied mobility of diatoms within the reach allows for alternate affects when being subjected to any change in flow conditions.

Percentage PTV scores across the sites were generally low and diatoms were classed as only being tolerant to no organic pollution, with the exception of the LRUS-002 autumn sample date which recorded a score indicative of having mild organic pollution tolerance.

Baseline diatom data provided by the London Effluent Reuse SRO monitoring programme show that TDI4 scores suggest that there is no organic pollution at the site. Overall EQR scores were calculated for each sample based on predicted TDI4 for observed alkalinity and season. Both sites recorded ‘good’ EQR scores within the reach, with LRUS-002 having scored ‘poor’ on the autumn sample date. Therefore, generally representative of good ecological health, however more sample dates are needed to understand this further (Figure 2-14).

³⁷ <https://environment.data.gov.uk/catchment-planning>

Figure 2-14 Diatom baseline data for Reach B



● LRUS - 002 ● LRUS - 003

Reach C – Thames Water Walton Intake to Teddington Weir

Reach C is within the WFD water body GB106039023232 (Thames (Egham to Teddington)) is classified as ‘poor for Macrophytes and Phytobenthos Combined in 2019 under Cycle 2³⁸. Baseline diatom data was provided by the Environment Agency and the London Effluent Reuse SRO monitoring programme for three sites in the freshwater River Thames (LRUS-004, LRUS - 005/ EA Site 35900 and LRUS-006), with Ricardo surveying all three sites twice in 2021 and LRUS - 005/ EA Site 35900 with two additional surveys by the Environment Agency (Table 2-19).

Table 2-19 Diatom monitoring in Reach C

Site ID	NGR	Survey count	Survey range	Max – Min (Avg.)				
				TDI4 % Motile	TDI4 % PTV	TDI4 % Salinity	TDI4 score	TDI4 EQR
LRUS - 004	TQ1529868498	2	26/10/2021 to 25/04/2022	30.82 - 7.99 (19.36)	6.85 - 3.73 (5.29)	1.37 - 0.69 (1.03)	71.4 - 66.2 (68.8)	0.61 - 0.6 (0.61)
LRUS - 005/ EA Site 35900	TQ1744067824	4	07/05/2010 to 25/04/2022	44.85 - 6.8 (24.32)	23.45 - 1.26 (9.69)	2.06 - 0 (0.9)	83.4 - 68.8 (75.99)	0.64- 0.3 (0.45)
LRUS - 006	TQ1741471171	2	26/10/2021 to 25/04/2022	42.42 - 21.28 (31.85)	20.39 - 11.21 (15.8)	1.38 - 0.92 (1.15)	73.2 - 54.1 (63.65)	0.95 - 0.54 (0.75)

The available diatom data within the zone of influence is not considered sufficient to provide an indication of the baseline community. This is because a long-term data set is not available for this site. Therefore, additional and more up to date surveys are required to understand current levels and give a larger, more robust dataset to understand baseline conditions further.

Following completion of the Gate 1 assessment, targeted diatom surveys were completed for the length of the River Thames and also at key locations downstream on behalf of the London Effluent Reuse SRO monitoring programme.

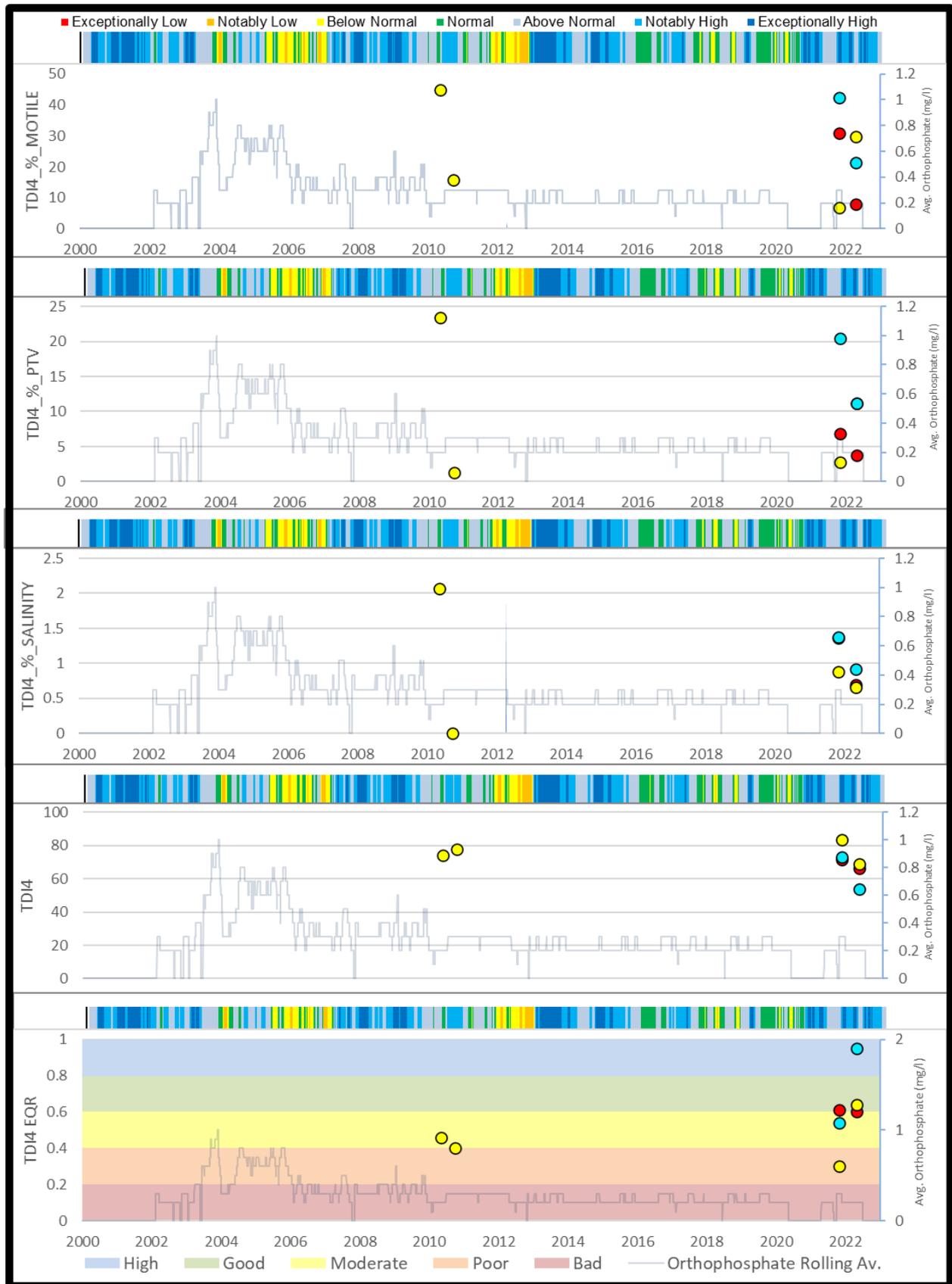
The percentage of the motile diatoms varied between the sites, with LRUS-002 having a higher percentage than LRUS-003. Having varied mobility of diatoms within the reach allows for alternate affects when being subjected to any change in flow conditions.

Percentage PTV scores across the sites were generally low and diatoms were classed as only being sensitive to organic pollution, with the exception of the LRUS-002 autumn sample date which recorded a score indicative of having mild organic pollution tolerance.

Overall EQR scores were calculated for each sample based on predicted TDI4 for observed alkalinity and season. Both sites recorded ‘good’ EQR scores within the reach, with LRUS-002 having scored ‘poor’ on the autumn sample date. Therefore, generally representative of good ecological health, however more sample dates are needed to understand this further (Figure 2-15).

³⁸ <https://environment.data.gov.uk/catchment-planning>

Figure 2-15 Diatom baseline data for Reach C



2.7.3 Estuarine Thames Tideway

Reach D – Teddington Weir to Battersea Park

There are no data available to make an assessment on diatoms within Reach D.

Reach E – Battersea Park to Tower Bridge

Reach E is within the transitional WFD water body GB530603911403 (THAMES UPPER) and is not classified for Macrophytes and Phytobenthos Combined in 2019 under Cycle 2³⁹. Baseline diatom data was provided by the Environment Agency for one site in the Upper Thames Tideway (EA Site 35861), with the site was surveyed six times between the years 2007 and 2014 (Table 2-20).

It should be noted that within UK transitional waters (which includes the Thames Tideway) there is no requirement to assess or classify diatoms in accordance with the WFD^{40, 41}. Given that diatom data was available for Reach E (and that this reach is predominantly oligohaline) then the WFD river and lake DARLEQ diatom tool has been used to help contextualise the data in order to form part of the aquatic ecology assessment.

Table 2-20 Diatom monitoring in Reach E

Site ID	NGR	Survey count	Survey range	Max – Min (Avg.)				
				TDI4 % Motile	TDI4 % PTV	TDI4 % Salinity	TDI4 score	TDI4 EQR
35861	TQ1701271462	6	28/11/2007 to 22/09/2014	73.15 - 18.11 (54.18)	47.84 - 2.3 (19.8)	20.98 – 0 (5.97)	85.62 - 68.53 (78.49)	0.65 - 0.16 (0.42)

The available diatom data within the zone of influence is, generally, is not considered sufficient to provide an indication of the baseline community. Although the data extends beyond ten years, the latest sample was taken in 2014, and therefore lacks up to date sampling. Therefore, additional and more up to date surveys are required to understand current levels and give a larger, more robust dataset to understand baseline conditions further.

Following completion of the Gate 1 assessment, targeted diatom surveys were completed for the length of the River Thames and also at key locations downstream on behalf of the London Effluent Reuse SRO monitoring programme.

The data shows a general low saline tolerance across all sample dates, with only one recording a saline tolerant score, with that being sampled in 2007. This therefore suggests there has been little influence of saline waters in this reach, and that any potential saline changes could impact the current diatom community within this reach (Figure 2-16).

The percentage of the motile diatoms was generally high across all sample dates. A high percentage of diatoms with motility within the reach suggests that there are current pressures increasing motility within the system.

Percentage PTV scores across the sample dates were generally low and diatoms were classed as being either tolerant to moderate or no organic pollution.

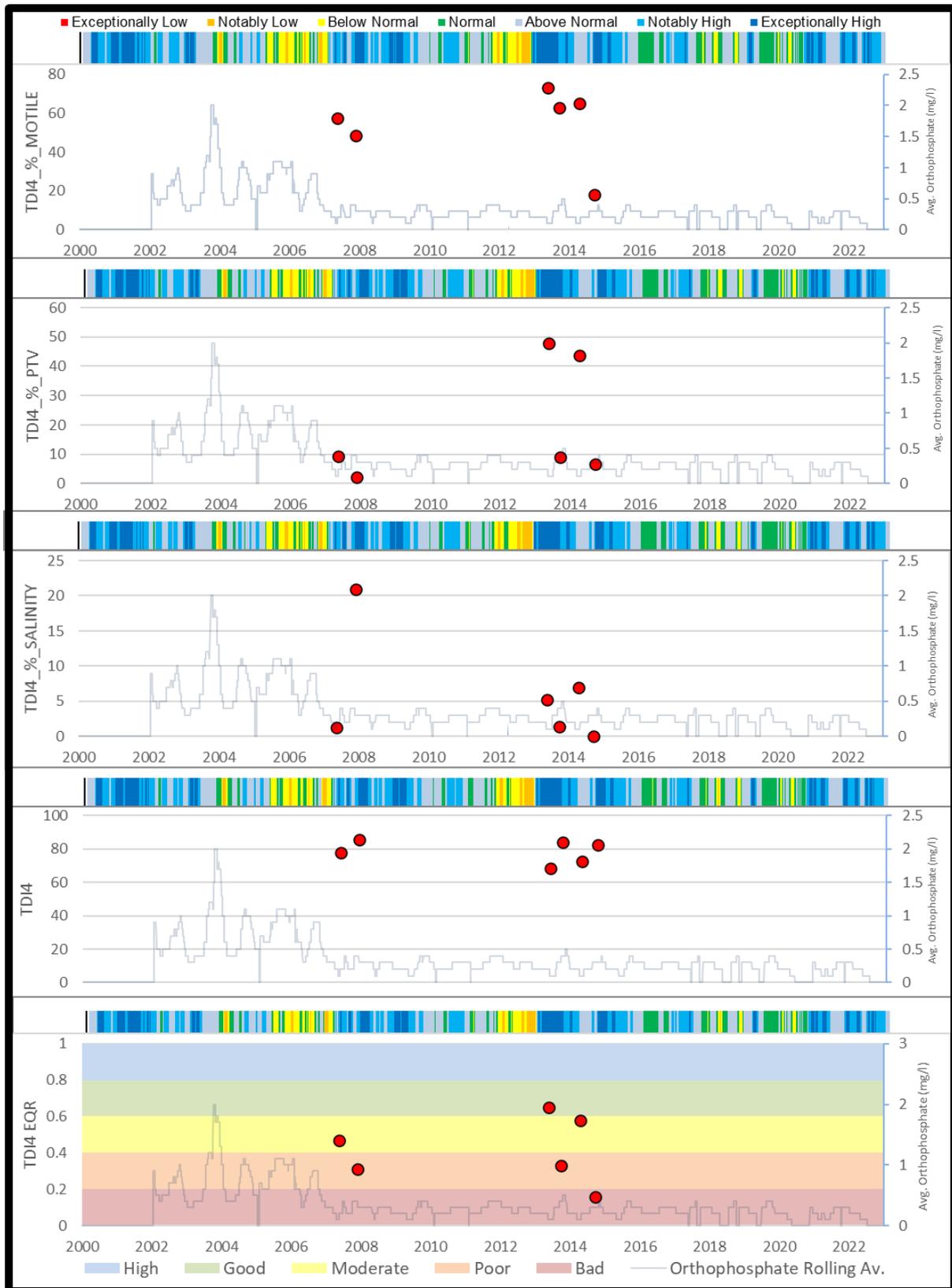
Overall EQR scores were calculated for each sample based on predicted TDI4 for observed alkalinity and season. Samples collected in this reach showed EQR scores of ‘poor’ and ‘moderate’, with the latest sample being classed as ‘bad’ in relation to ecological health (Figure 2-16).

³⁹ <https://environment.data.gov.uk/catchment-planning>

⁴⁰ The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. SI 2003 No 3242.

⁴¹ Note that diatom communities fall within the species composition of the Transitional Water Phytoplankton Tool; ISBN: 978-1-906934-41-5, but are not assessed as a WFD biological quality element.

Figure 2-16 Diatom baseline data for Reach E



● 35861

Reach F Tower Bridge to 3km seawards of Beckton STW

There are no data available to make an assessment on diatoms within Reach F.

2.7.4 Freshwater Lee Diversion Channel

Reach G – Newmans Weir on the Enfield Island Loop to Chingford Abstractions

The WFD water body GB106038027950 (Lea Navigation Enfield Lock to Tottenham Locks Water Body) is classified as ‘Poor’ for Macrophytes and Phytobenthos Combined in 2019 under Cycle 2⁴². Baseline diatom data was provided by the London Effluent Reuse SRO monitoring programme for one site in the River Lee (ID LRUS – 016).

Ricardo has collected diatom data at ID LRUS – 016, sampled twice in the within Reach G during the study period (Table 2-21).

Table 2-21 Diatom monitoring in Reach G

Site ID	NGR	Survey count	Survey range	Max – Min (Avg.)				
				TDI4 % Motile	TDI4 % PTV	TDI4 % Salinity	TDI4 score	TDI4 EQR
LRUS - 016	TQ3728398177	2	29/10/2021 to 26/04/2022	23.96 - 10.93 (17.45)	14.52 - 4.88 (9.7)	1.4 - 0.23 (0.81)	67.0 – 66.4 (66.7)	0.69 - 0.69 (0.68)

The available diatom data within the zone of influence is not considered sufficient to provide an indication of the baseline community. This is because a long-term data set is not available for this site. Therefore, additional and more up to date surveys are required to understand current levels and give a larger, more robust dataset to understand baseline conditions further.

Following completion of the Gate 1 assessment, targeted diatom surveys were completed for the River Lee and also at key locations downstream on behalf of the London Effluent Reuse SRO monitoring programme.

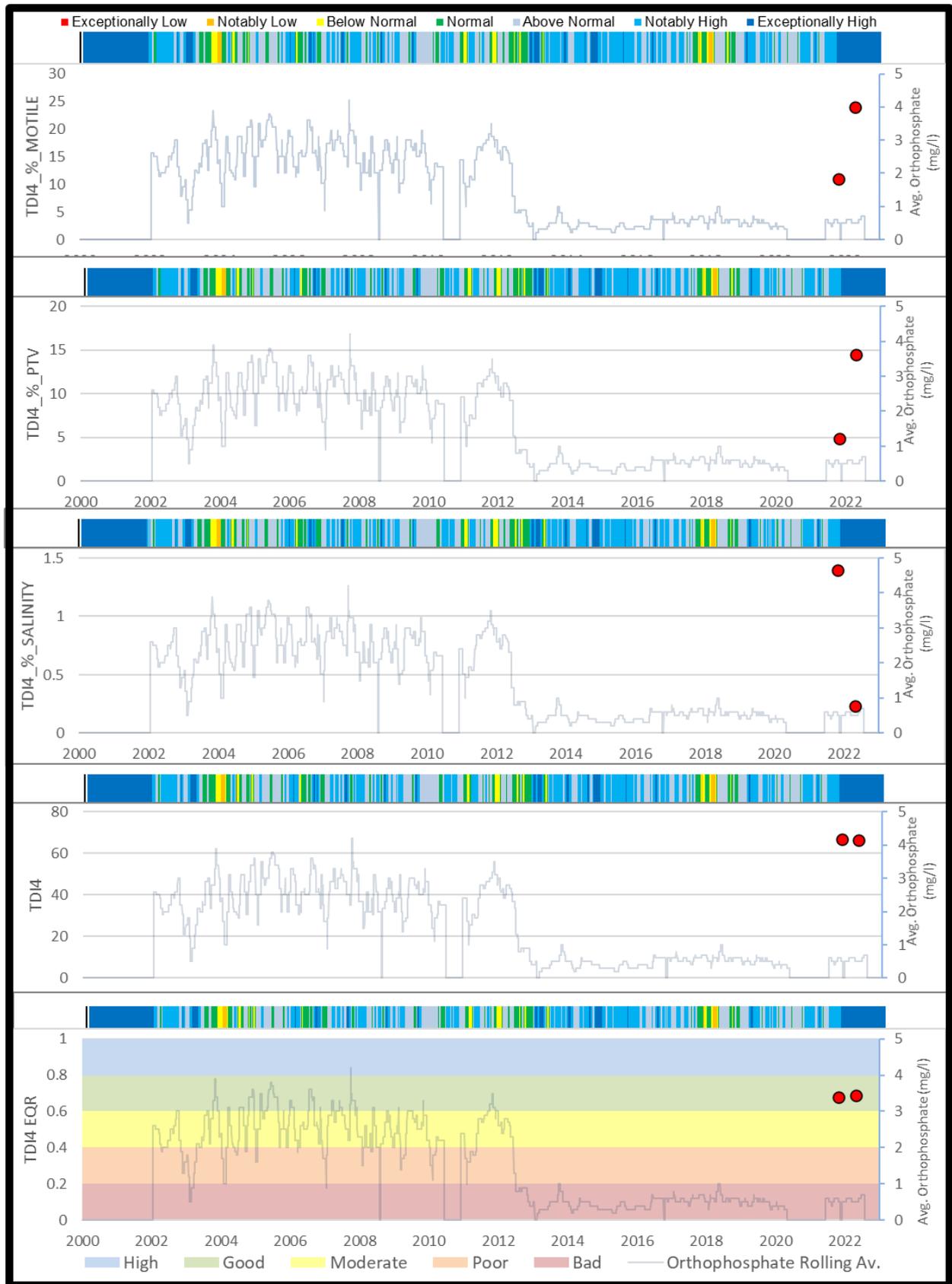
The percentage of the motile diatoms at the site also recorded low scores. This therefore suggests the environment is typically stable and that the majority of diatoms within the reach will be affected by changing flow conditions if subjected to them (Figure 2-17).

Percentage PTV scores across LRUS-016 show the diatoms in this reach have a low tolerance to organic pollution. Therefore, any extra organic input into this reach will have an effect on the diatom communities currently present.

Overall EQR scores were calculated for each sample based on predicted TDI4 for observed alkalinity and season. All samples taken from this site recorded EQR scores of ‘good’.

⁴² <https://environment.data.gov.uk/catchment-planning>

Figure 2-17 Diatom baseline data for Reach G



● LRUS - 016

Reach H – Chingford Abstractions to Three Mills Lock

The WFD water bodies GB106038077852 (Lee (Tottenham Locks to Bow Locks/Three Mills Locks)) and GB106038027910 (Pymmes and Salmon Brooks - Deephams STW to Tottenham Locks) are both classified as ‘moderate’ for Macrophytes and Phytobenthos Combined in 2019 under Cycle 2⁴³. Baseline diatom data was provided by the Environment Agency for eight sites (ID 154086, 34101, 148359, 156467, 148358, 33815, 34076 and 34160). The Environment Agency has collected diatom data at the sites on 19 occurrences within Reach H during the study period (Table 2-22).

Table 2-22 Diatom monitoring in Reach H

Site ID	NGR	Survey count	Survey range	Max – Min (Avg.)				
				TDI4 % Motile	TDI4 % PTV	TDI4 % Salinity	TDI4 score	TDI4 EQR
154086	TQ3508690495	4	26/05/2010 to 24/09/2014	88.22 - 13.02 (54.49)	45.53 - 15.87 (30.81)	43.65 - 0 (21.14)	81.93 - 8.99 (70.49)	0.87 - 0.39 (0.63)
34101	TQ3474589511	3	10/07/2006 to 19/04/2013	41.86 - 12.62 (30.4)	6.40 - 2.99 (4.19)	4.65 - 0.83 (2.52)	82.71 - 70.76 (77.21)	0.64 - 0.39 (0.5)
148359	TQ3465088750	1	10/07/2006 to 10/07/2006	49.87	8.10	0.25	69.8	0.65
156467	TQ3436888594	1	09/11/2009 to 09/11/2009	21.92	6.58	3.56	75.1	0.53
148358	TQ3475087600	2	10/07/2006 to 03/11/2009	34.13 - 12.17 (23.15)	8.68 - 4.87 (6.78)	1.8 - 0.24 (1.02)	68.82 - 64.4 (66.61)	0.76 - 0.68 (0.72)
33815	TQ3480087600	2	26/05/2010 to 04/10/2010	27.67 - 23.51 (25.59)	27.0 - 18.54 (22.77)	3.97 - 2.0 (2.99)	70.01 - 62.93 (66.47)	0.79 - 0.64 (0.72)
34076	TQ3570086500	2	10/07/2006 to 03/11/2009	71.83 - 24.18 (48.01)	10.15 - 6.48 (8.32)	6.76 - 2.09 (4.43)	71.43 - 60.83 (66.13)	0.84 - 0.61 (0.73)
34160	TQ3651586502	4	17/05/2010 to 06/09/2013	35.17 - 13.33 (24.75)	31.65 - 8.63 (20.59)	2.72 - 0 (1.24)	75.66 - 61.6 (69.57)	0.82 - 0.54 (0.66)

The available diatom data within the zone of influence is, generally, considered sufficient to provide an indication of the baseline community. This is because a long-term data set is available for one site, however, additional, more up to date surveys are required to understand current levels and give a larger, more robust dataset to understand baseline conditions further.

Following completion of the Gate 1 assessment, targeted diatom surveys were completed for the length of the River Lee and also at key locations downstream on behalf of the London Effluent Reuse SRO monitoring programme.

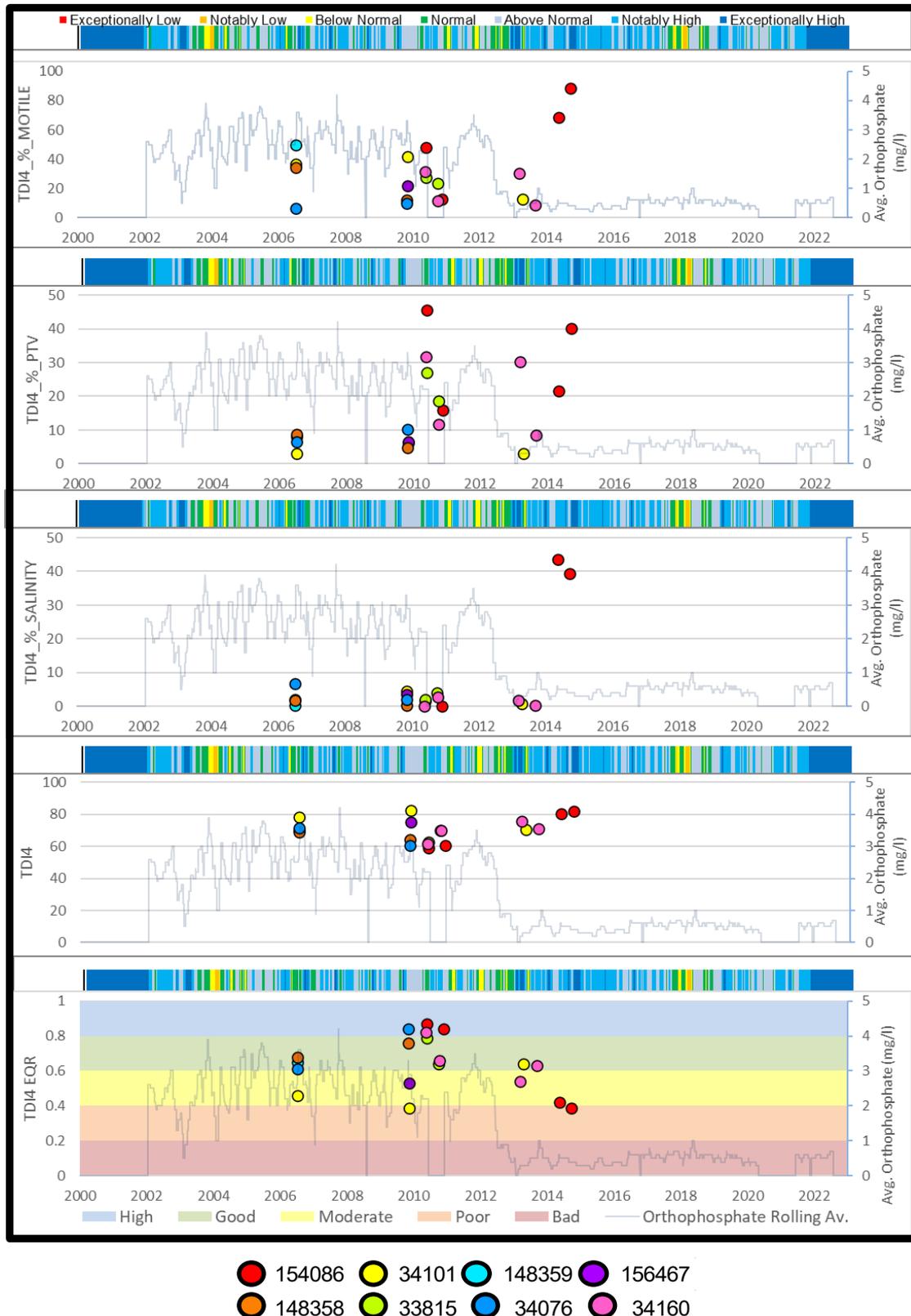
The percentage of the motile diatoms across the sites vary along the reach. Although most sites are generally low in motility, site 154086, in the upper most of this reach was found in baseline data to have a highly motile

⁴³ <https://environment.data.gov.uk/catchment-planning>

percentage of diatoms over the sampled dates. This suggests that there are current pressures increasing motility within the system. (Figure 2-18).

Percentage PTV scores across all sites show a general trend of no organic pollution. Overall EQR scores were calculated for each sample based on predicted TDI4 for observed alkalinity and season. The majority of sites recorded EQR scores of 'good' and above, with only two samples within sites scoring 'poor'.

Figure 2-18 Diatom baseline data for Reach H



Reach I - Estuarine Bow Creek (tidal Lee) Reach I: Three Mills Lock to Thames Tideway

There are no data available to make an assessment on diatoms within Reach I.

2.8 MACROALGAE, ANGIOSPERM AND PHYTOPLANKTON

2.8.1 Overview

This section sets out the reference conditions for the macroalgae, angiosperm and phytoplankton assessment:

- Estuarine Thames Tideway – Section 2.8.2

The evidence available, the general patterns observed in the data and any notable pressures are outlined for each of these reaches in the following sections.

It is noted that there is Environment Agency monitoring data available for the estuarine Thames Tideway from 2014, however, these surveys were presence/absence only and are therefore not suitable to include in this assessment.

2.8.2 Estuarine Thames Tideway

Reach D – Teddington Weir to Battersea Park

A macroalgae survey was undertaken on the estuarine Thames Tideway in 2020⁴⁴ within Reach D (Table 2-23).

Table 2-23 Macroalgae monitoring in Reach D

Location	Survey range	Measurement	Result
Estuarine River Thames (TQ 16756 76025)	21/09/2020	Percentage cover	<i>Vaucheria spp.</i> – 20-80% (Site A) <i>Vaucheria spp.</i> – 60-80% (Site B) <i>Vaucheria spp.</i> – 40-50% (Site C)
		Available intertidal habitat	Site A – 5.1% Site B – 16% Site C – 16.7% Overall – 8.5%
		Biomass (mean)	Site A – 88.67 g/m ² Site B – 82.84 g/m ² Site C – 100.48 g/m ²
		Entrainment	Not applicable

The only algal taxon recorded in Reach D (at Isleworth Ait) was *Vaucheria* which is a genus of yellow-green algae. *Vaucheria* species are mostly found in freshwater or low salinity estuarine waters while a small number are fully marine. *Vaucheria spp.* Was noted to be patchily distributed and the percent coverage of the AIH across the survey sites in Reach D was 8.5%.

Baseline data indicates that within this reach, the biological status of the macroalgal community is considered Bad, based on the calculated EQR values (<0). This suggests that the macroalgal community within this reach is in an impacted state. See Table 2-3 above (Section 2.2) for guidance in interpreting EQR scores.

Macroalgae surveys are planned to be undertaken during August 2022 and the results of this survey will be used to inform the Gate 3 process. Marine angiosperms are not present within Reach D due to the oligohaline nature of this freshwater tidal reach of the Thames Tideway.

Phytoplankton data

Phytoplankton data is available for this Reach at EA Site 156466 from 2015 to 2021 (Table 2-24).

⁴⁴ Atkins/Apem Technical Note, 2020, Thames Water SRO's macroalgal monitoring 2020

Table 2-24 Phytoplankton monitoring in Reach D

Location	Survey range	Survey count	Measurement	Result
Estuarine River Thames (TQ2265778260)	08/02/2021 - 26/06/2021	5	Chlorophyll-a 90 th percentile metric	No data
			Elevated count multimetric	Not applicable
			Seasonal Succession Index	100%
Estuarine River Thames (TQ2265778260)	21/01/2020 - 01/12/2020	4	Chlorophyll-a 90 th percentile metric	No data
			Elevated count multimetric	Not applicable
			Seasonal Succession Index	100%
Estuarine River Thames (TQ2265778260)	15/04/2019 - 09/12/2019	9	Chlorophyll-a 90 th percentile metric	No data
			Elevated count multimetric	Not applicable
			Seasonal Succession Index	100%
Estuarine River Thames (TQ2265778260)	10/01/2017 - 10/03/2017	3	Chlorophyll-a 90 th percentile metric	No data
			Elevated count multimetric	Not applicable
			Seasonal Succession Index	100%
Estuarine River Thames (TQ2265778260)	07/01/2016 - 15/09/2016	9	Chlorophyll-a 90 th percentile metric	No data
			Elevated count multimetric	Not applicable
			Seasonal Succession Index	100%
Estuarine River Thames (TQ2265778260)	19/01/2015 - 08/12/2015	12	Chlorophyll-a 90 th percentile metric	No data
			Elevated count multimetric	Not applicable
			Seasonal Succession Index	100%

Baseline data indicates that within this reach, the biological status of the phytoplankton community is considered High, based on the calculated EQR values (1.0), though this is only for the seasonal succession index. This suggests that the phytoplankton community within this reach is not in an impacted state. See Table 2-4 above (Section 2.2) for guidance in interpreting EQR scores.

Reach E – Battersea Park to Tower Bridge

No data are available for this Reach for macroalgae or phytoplankton.

Macroalgae surveys were undertaken during September 2022 and the results of this survey will be used to inform the Gate 3 process. Marine angiosperms are not present within Reach E due to the oligohaline nature of this reach of the Thames Tideway.

Reach F Tower Bridge to 3km seawards of Beckton STW

A macroalgae survey was undertaken on the estuarine Thames Tideway in 2020²⁹ within Reach F (Table 2-25).

Table 2-25 Macroalgae monitoring in Reach F

Location	Survey range	Measurement	Result
Estuarine River Thames (TQ 47530 82182)	24/09/2020	Percentage cover	<i>Ulva</i> spp. – 12-84% <i>Fucus vesiculosus</i> – 12-16%
		Available intertidal habitat	No measurement taken
		Biomass (mean)	No measurement taken
		Entrainment	Not applicable

Location	Survey range	Measurement	Result
Tidal River Roding (TQ 45739 81650)	22/09/2020	Percentage cover	<i>Ulva spp.</i> – 8-45%
		Available intertidal habitat	No measurement taken
		Biomass (mean)	No measurement taken
		Entrainment	Not applicable

No opportunistic algae were recorded on soft sediment at either site in in Reach F. *Ulva spp.* was recorded on hard substrates, along with *Fucus vesiculosus* on riprap on the upper shore at the estuarine Thames Tideway survey area. However, macroalgae on hard substrate is not a consideration of the WFD Opportunistic Macroalgal Blooming Tool and is not used to assess the status of opportunistic macroalgae in WFD water bodies.

Macroalgae surveys are planned to be undertaken during August 2022 and the results of this survey will be used to inform the Gate 3 process. Marine angiosperms are not present within Reach E due to the mesohaline nature of this reach of the Thames Tideway.

No data are available for this Reach for phytoplankton.

2.9 DESIGNATED AND PROTECTED SITES AND SPECIES

2.9.1 Overview

This section sets out the reference conditions for the designated and protected sites and species assessment:

- Freshwater River Thames - Section 2.9.2
- Estuarine Thames Tideway – Section 2.9.3
- Freshwater Lee Diversion Channel – Section 2.9.4

The evidence available, the general patterns observed in the data and any notable pressures are outlined for each of these reaches in the following sections.

2.9.2 Freshwater River Thames

Reach A – Shepperton Weir to Affinity Water Walton Intake

Three designated sites were identified within 2km of Reach A, Dumsey Meadows SSSI, Chertsey Meads LNR and Ash Link LNR. The location of the designated sites relative to each reach and presence of water dependent features are presented in Table 2-26.

Table 2-26 Designated sites within 2km of Reach A

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
Dumsey Meadows SSSI	1.86km west	Potential	No – upstream of impacted Reach A	- Species-rich grassland - Rare floral species including marsh arrow-grass and meadow-rue
Chertsey Meads LNR	1.02km west	Unknown	No – upstream of impacted Reach A	- Birds including lesser whitethroat, reed bunting and sedge and reed warbler - Unusual plant species including meadow cranesbill and clustered crane-flower
Ash Link LNR	1.85km north	Unknown	No – LNR located on River Ash which feeds into River Thames in Reach B	- Mixed woodlands - Wildflower glades

Dumsey Meadow SSSI

The site is an unimproved, cattle and pony-grazed riverside pasture situated on the floodplain of the freshwater River Thames and represents an area of unimproved neutral grassland that is now very rare in southeast England, and which has almost disappeared in the Thames Valley. The site consists of species-rich grassland, locally dominated by a mixture of grasses, and is variable in character ranging from tall vegetation in damp depressions to dry ridges with a short turf. The site supports a great diversity of relatively common floral species, with a couple of species rare in the county including marsh arrow-grass (*Triglochin palustris*) and meadow-rue (*Thalictrum flavum*).

Chertsey Meads LNR

Chertsey Meads LNR is located to the east of Chertsey on the right bank of the River Thames and consists of 38ha of grassland. The site was traditionally managed as a hay meadow with cattle grazing and this management technique is being re-employed in some areas to determine whether this technique can increase the range of flora and fauna species on the site and achieve SSSI status. A diverse range of bird species have been recorded at the site including lesser whitethroat (*Sylvia curruca*), skylark (*Alauda arvensis*), sedge warbler (*Acrocephalus schoenbaenus*) and reed warbler (*A. scirpaceus*).

Ash Link LNR

Ash Link LNR is located to the north of Shepperton on the right bank of the River Ash, either side of the M3. The south-east section of the site is characterised by meadow and the northwest section by mixed woodland.

Reach B – Affinity Water Walton Intake to Thames Water Walton Intake

Five designated sites were identified within 2 km of Reach B, Knight & Bessborough Reservoirs SSSI, Southwest London Waterbodies SPA and Ramsar, Kempton Park Reservoirs SSSI, Kempton park LNR. The location of designated sites relative to Reach B and presence of water dependent features is identified in Table 2-27.

The Knight & Bessborough Reservoirs SSSI is a constituent component of the Southwest London Waterbodies SPA and Ramsar. The potential impacts to the Southwest London Waterbodies SPA are presented in the London Effluent Reuse SRO Habitat Regulations Assessment (Annex B.3).

Table 2-27 Designated sites within 2km of Reach B

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
Knight & Bessborough Reservoirs SSSI	0.55 km south	Yes	No	- Wintering gadwall and shoveler - Other wintering wildfowl including goldeneye, pochard, shelduck, teal, wigeon, goosander and tufted duck
Southwest London Waterbodies SPA	0.55 km south	Yes	No	- Wintering gadwall and shoveler
Southwest London Waterbodies Ramsar	0.55 km south	Yes	No	- Wintering gadwall and shoveler
Kempton Park Reservoirs SSSI	1.22 km north-east	Yes	No	- Wintering gadwall and shoveler
Kempton park local nature reserve	1.6 km north - east	Yes	No	- Reed bed habitat and associated birds including bearded tits, sedge warblers and other reed-dependent species - Wading birds

Knight & Bessborough Reservoirs SSSI

Knight and Bessborough Reservoirs SSSI consists of two connected embanked water storage reservoirs. The waterbodies are of interest for the populations of waterfowls they support including nationally important populations of wintering shoveler. The reservoirs also support notable populations of wintering gadwall (*Anas strepera*), cormorant (*Phalacrocorax carbo*), and goldeneye (*Bucephala clangula*).

Kempton Park Reservoirs SSSI and LNR

Kempton Park Reservoirs SSSI are of national importance for wintering gadwall.

In addition to the nationally important numbers of gadwall, the site supports significant numbers of wintering shoveler (*Anas clypeata*). The woodland surrounding the reservoirs also support a range of protected mammals, reptiles, and amphibians

Reach C – Thames Water Walton Intake to Teddington Weir

Twelve designated sites were identified within 2 km of Reach C: Kempton Park Reservoirs SSSI, Kempton Park LNR, Molesley Heath LNR, Bushy Park and Home Park SSSI, Stokes Field LNR, Oak Hill Wood LNR, Richmond Park NNR, Richmond Park SSSI, Richmond Park SAC, Ham common LNR, Oak Avenue Hampton LNR and Ham Lands LNR. The location of designated sites relative to Reach C and presence of water dependent features is identified in Table 2-28.

The Richmond Park SSSI is a constituent component of the Richmond Park SAC. The potential impacts to the Richmond Park SAC are presented in the London Effluent Reuse SRO Habitat Regulations Assessment (Annex B.3).

Table 2-28 Designated sites within 2km of Reach C

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
Kempton Park Reservoirs SSSI	1.02km - north	Yes	No	- Wintering gadwall and shoveler
Molesley Heath LNR	1.46km south	Yes	No	- Diverse bird and invertebrate communities
Kempton park local nature reserve	1.5km north	Yes	No	- Reed bed habitat and associated birds including bearded tits, sedge warblers and other reed-dependent species - Wading birds
Bushy Park and Home Park SSSI	0.03km from left bank	No	No	- Nationally important saproxylic (dead and decaying wood associated) invertebrate assemblage - Veteran trees and acid grassland communities
Stokes Field LNR	1.12km south	No	No	- Woodland, grassland, scrub - Notable plant species including crab apple, cuckoo flower and pyramidal orchid
Oak Hill Woods LNR	1km south	Yes	No	- Woodlands supporting mature trees including pedunculate oak, hornbeam, ash and wild service tree
Richmond Park NNR	1.25km east	No	No	- Diverse deadwood beetle fauna - Stag beetle - Ancient trees
Richmond Park SSSI	1.25km east	No	No	- Diverse deadwood beetle fauna - Stag beetle - Ancient trees

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
Richmond Park SAC	1.25km east	No	No	- Stag beetle
Ham common, Richmond LNR	0.85km east	Yes	No	- Birch and oak woodland
Oak Avenue Hampton LNR	1.91km north	No	No	- Hedgerows and wildflower meadow
Ham Lands LNR	0.10km north	Yes	Yes	- Butterfly and bird communities - Flood meadow habitat with associated scrub vegetation

Kempton Park Reservoirs SSSI and LNR

The designated features of the sites are described in the Reach B section.

Molesey Heath LNR

Molesey Heath is a reclaimed landfill site, which was formerly a gravel pit. The whole site has been colonised naturally by rough grassland and scrub. The site supports diverse bird and invertebrate communities.

Bushy Park and Home Park SSSI

Bushy Park and Home Park SSSI is of special interest for its nationally important saproxylic (dead and decaying wood associated) invertebrate assemblage, population of veteran trees and acid grassland communities. These features occur within and are supported by the wider habitat mosaic. The saproxylic invertebrates include those associated with heartwood decay, bark and sapwood decay and with fungal fruiting-bodies found within the veteran trees which are located throughout the site.

Stokes field LNR

Stokes Field is an urban fringe site with a variety of habitats including woodland, grassland and scrub. It also has a pond. Plant species of note include crab apple (*Malus sylvestris*), cuckoo flower (*Cardamine pratensis*), and pyramidal orchid (*Anacamptis pyramidalis*).

Oak Hill Woods LNR

Oak Hill Woods is designated for woodlands that support mature trees, such as pendunculate oak (*Quercus robur*), hornbeam (*Carpinus Betula*), ash (*Fraxinus excelsior*) and the wild service tree (*Sorbus torminalis*). The Pymmes Brook runs through the park bordered by with a couple of small tributaries flowing through the woods.

Richmond Park SSSI, NNR, and LNR

Richmond Park has been managed as a royal deer park since the seventeenth century, producing a range of habitats of value to wildlife. In particular, Richmond Park is of importance for its diverse deadwood beetle fauna associated with the ancient trees found throughout the parkland. In addition, the Park supports the most extensive area of dry acid grassland in Greater London. The site supports an internationally important population of stag beetle (*Lucanus cervus*),

Ham Common LNR

The site supports birch and oak woodland with wet hollows and acid grassland.

Oak Avenue Hampton LNR

This site is located to the northwest of Hampton and was re-landscaped from its previous use as nursery gardens and greenhouses. The site now has native hedgerows, footpaths and wildflower meadows.

Ham Lands LNR

The Ham Lands LNR is located on the right bank of the River Thames, this site is designated for the presence of flood meadow habitat with associated scrub vegetation, including hawthorn (*Crataegus monogyna*). The site supports butterfly and bird communities. The Surrey Habitat Action Plan for floodplain grazing marsh

identifies abstraction as a factor that can affect the habitat where it leads to: lowered river flows and water levels; lower water levels in wetland areas; and exacerbation of drought-related problems.

2.9.3 Estuarine Thames Tideway

Reach D – Teddington Weir to Battersea Park

Sixteen designated sites were identified within 2 km of Reach D: Bushy Park and Home Park SSSI, Ham common LNR, Richmond Park NNR, Richmond Park SSSI, Richmond Park SAC, Ham Lands LNR, Isleworth Ait LNR, Syon Park SSSI, Blondin Park, Northfield LNR, Gunnersbury Triangle LNR, Barn Elms Wetland Centre SSSI, Barnes Common LNR, Duke’s Hollow LNR, Chiswick Eyot LNR, Leg of Mutton Reservoir LNR and Battersea Park Nature Areas LNR. The location of designated sites relative to Reach D and presence of water dependent features is identified in Table 2-29.

The Richmond Park SSSI is a constituent component of the Richmond Park SAC. The potential impacts to the Richmond Park SAC are presented in the London Effluent Reuse SRO Habitat Regulations Assessment (Annex B.3).

Table 2-29 Designated sites within 2km of Reach D

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
Bushy Park and Home Park SSSI	1.23km southwest	No	No – upstream of the impacted reach	- Nationally important saproxylic (dead and decaying wood associated) invertebrate assemblage - Veteran trees and acid grassland communities
Ham common LNR	1km east	Yes	No	- Birch and oak woodland
Richmond Park NNR	0.5km east	No	No	- Diverse deadwood beetle fauna - Stag beetle - Ancient trees
Richmond Park SSSI	0.5km east	No	No	- Diverse deadwood beetle fauna - Stag beetle - Ancient trees
Richmond Park SAC	0.5km east	No	No	- Stag beetle
Ham Lands LNR	0km east	Yes	Yes	- Butterfly and bird communities - Flood meadow habitat with associated scrub vegetation
Isleworth Ait LNR	Island in the Thames	Yes	Yes	- Rare mollusc species two lipped door snail and German hairy snail
Syon Park SSSI	0km west	Yes	Yes	- Rare invertebrate species (a new species of snail to Britain (<i>Perforatella rubiginosa</i>) and the moth <i>Serniothisa notata</i>) - Tall wet grassland community
Blondin Park, Northfield LNR	1.77km north	No	No	- Orchard, wildflower meadow and pond habitats
Gunnersbury Triangle LNR	0.98km east	Yes	No	- Birch and willow woodland - Pond, marsh and meadow habitats with mammal and invertebrate communities
Barn Elms Wetland Centre SSSI	Up to Thames bank	Yes	Yes	- Wetland habitats - Wintering and breeding birds including shoveler and gadwall

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
				- Mammal populations including water vole and bats
Barnes Common LNR	0.65km south	No	No	- Grassland, scrub and woodland - Green woodpeckers - White-flowered burnet rose
Duke's Hollow LNR	0km north	Yes	Yes	- Rare mollusc species two lipped door snail (<i>Balea biplicata</i>) and German hairy snail (<i>Perforatella rubiginosa</i>).
Chiswick Eyot LNR	0km north	Yes	Yes	- Bird communities
Leg of Mutton Reservoir LNR	0km east	Yes	Yes	- Birds including teal, tufted duck, wigeon and shovelers
Battersea Park Nature Areas LNR	1.21km east	Yes	Unknown	- Woodland, meadow and pond habitats - Woodland bird species including blackcap and bullfinch - Invertebrate communities including white lesser hairstreak, stag beetles, and lesser stag beetles

Bushy Park and Home Park SSSI

The designated features of the sites are described in the Reach C section.

Richmond Park SSSI, NNR, and LNR

The designated features of the sites are described in the Reach C section.

Ham Common LNR

The designated features of the sites are described in the Reach C section.

Ham Lands LNR

The designated features of the sites are described in the Reach C section.

Isleworth Ait LNR

Isleworth Ait LNR is located on an island within the middle of the Thames Tideway, upstream of Syon Park SSSI, and is relatively undisturbed, being accessible only by boat and by appointment with TWUL (owners). Regular flooding of the site has created an area of mixed woodland with poplar (*Populus* species) and willow (*Salix* species). The site is designated as it supports two rare species of mollusc: the two-lipped door (*Balea biplicata*) snail and German hairy snail (*Perforatella rubiginosa*). The two-lipped door snail is only found in one other location other than the River Thames, which is Purfleet in Essex. The two lipped door snail is an air breathing land snail is not considered to be sensitive to changes in flow rate, reductions in water level, or changes in water quality in the river Thames.

The German hairy snail is an amphibious species that inhabits marginal habitats in freshwater tidal reaches with tall nitrophilous vegetation.

Syon Park SSSI

The site is the only known area of tall grass washland along the Thames Tideway in Greater London, supporting several invertebrate species with a restricted distribution both locally and nationally (a new species of snail to Britain (*Perforatella rubiginosa*), the moth (*Serniothisa notata*) and a number of uncommon fly species: *Cheilotricha imbuta*; *Stratiomys potamida*, *Meliera crassipennis*; *Xylomia marginata* and *Limonia trivittata*. Tide Meadow at Syon Park consists of a tall wet grassland community of reed-grasses; *Glyceria maxima* and *Phalaris arundinacea*, which grades into a drier semi-improved grassland on the higher ground. Along the river bank a fringe of damp woodland has developed, which is rich in species and hybrids of willow

species and poplar species. Numerous small ditches dissect the site, running from the grassland, through the woodland strip, down to the Thames. The intertidal muds adjacent to the Thames are regularly used by heron and support wintering birds.

The SSSI condition assessment, last undertaken in April 2017, identified that the entire site is in Favourable condition.

Blondin Park, Northfields LNR

The Park and LNR contains a community orchard, wildflower meadow, and pond.

Gunnersbury Triangle LNR

The site contains birch and willow woodland with pond, marsh and meadow habitats that support mammal and invertebrate communities.

Barn Elms Wetland Centre SSSI

The site comprises a mosaic of different wetland habitats that support nationally important wintering populations of shoveler and an assemblage of breeding birds associated with lowland waters and their margins.

The wetland habitats have been constructed on the site of redundant artificial reservoir basins, with the majority of the site made up of standing open water, grazing marsh and reedbed. Other significant habitats present include carr woodland, scrub and mesotrophic grassland.

In addition to nationally important levels of shoveler, the site supports significant numbers of gadwall and an outstanding assemblage of regularly breeding birds associated with lowland open waters and their margins. Mammals are also well represented on the site, with water vole (*Arvicola amphibious*) and several species of bat present.

The SSSI condition assessment, last undertaken in March 2012, identified that the entire site is in a favourable condition.

Barnes Common LNR

Barnes Common contains areas of open grassland, trees, scrub and woodland. The site supports green woodpeckers (*Picus viridis*) and white-flowered burnet rose (*Rosa pimpinellifolia*).

Duke's Hollow LNR

This site is located on the north bank of the Thames Tideway and has a natural tidal foreshore with a variety of waterside plants. The site has two nationally rare snails, the two lipped door snail and the German hairy snail.

Chiswick Eyot LNR

Chiswick Eyot is an unbridged tidal island in the Thames Tideway. There is little information regarding the reasons for designating this site and notable habitats or species.

Leg of Mutton Reservoir LNR

Leg of Mutton Reservoir is located on the east of the Thames Tideway. This site is a former reservoir with breeding and wintering water birds including teal, tufted duck, wigeon, shovelers, heron and kestrels.

Battersea Park Nature Areas LNR

The LNR comprises a plantation woodland with four glades and a pond in addition to a meadow with a circular belt of mixed woodland and scrub surrounding a managed meadow area.

The LNR supports a range of woodland bird species including blackcap and bullfinch. Invertebrate species present include 20 species of butterfly including white letter hairstreak. Stag beetles and lesser stag beetles can frequently be seen in May. Particularly notable species of invertebrates include the flower bug (*Anthocoris minkii*) and the nationally notable hoverfly (*Volucella zonaria*).

Reach E – Battersea Park to Tower Bridge

One designated site, Battersea Park Nature Areas LNR was identified within 2 km of Reach E. The location of designated sites relative to reach and presence of water dependent features is identified in Table 2-30.

Table 2-30 Designated sites within 2km of Reach E

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
Battersea Park Nature Areas LNR	0.07 km south of the river Thames	Yes	Unknown	<ul style="list-style-type: none"> - Woodland, meadow and pond habitats - Woodland bird species including blackcap and bullfinch - Invertebrate communities including white lesser hairstreak, stag beetles, and lesser stag beetles

Battersea Park Nature Areas LNR

The designated features of the sites are described in the Reach D assessment.

Reach F - Tower Bridge to 3km seawards of Beckton STW

Thirteen designated sites were identified within 2 km of Reach F: Lavender Pond LNR, Russia Dock woodland LNR, Mudchute Park/farm LNR, Tower hamlets cemetery LNR, Ackroyd Drive Greenlink LNR, Sue Godfrey Nature Park LNR, Gilbert's Pit and Maryon Park LNR, Gilbert's Pit (Charlton) SSSI, Crossness LNR, Ripple Nature Reserve LNR, Stave Hill Ecology Park LNR, Brookmill Road LNR and Scrattons Ecopark and extension LNR. The location of designated sites relative to Reach F and presence of water dependent features is identified in Table 2-31.

Table 2-31 Designated sites within 2km of Reach F

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
Lavender Pond LNR	0.08 km south	Yes	No	<ul style="list-style-type: none"> - Reed beds, open water and islands - Invertebrate communities including damselflies
Russia Dock woodland LNR	0.08 km south	Yes	No	<ul style="list-style-type: none"> - Ponds and woodlands
Mudchute Park/farm LNR	0.26 km	Yes	No	<ul style="list-style-type: none"> - Grazing pastures, wildflower banks, woodland, hedgerows, ponds, wetlands
Tower hamlets cemetery LNR	1.4 km north	Yes	No	<ul style="list-style-type: none"> - Ancient woodlands and wildflowers - Butterfly communities - Bird communities
Ackroyd Drive Greenlink LNR	1.1 km north	No	No	<ul style="list-style-type: none"> - Green corridor with grassland and woodland habitats
Sue Godfrey Nature Park LNR	0.5 km south	No	No	<ul style="list-style-type: none"> - Rough grassland, scrub and ruderal vegetation
Gilbert's Pit (Charlton) LNR (Maryon Park)	0.5 km south	No	No	<ul style="list-style-type: none"> - Acid grassland, scrub and woodland - Assemblage of burrowing bees and wasps
Gilbert's Pit (Charlton) SSSI	0.5 km south	No	No	<ul style="list-style-type: none"> - One of the most complete sections through the Lower Tertiary beds in Greater London area
Crossness LNR	1 km- east	Yes	No – downstream of	<ul style="list-style-type: none"> - Ditch network, open water, scrub and rough grassland - Water vole

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
			the impacted reach	- Bird populations - Rare aquatic and terrestrial invertebrates
Ripple Nature Reserve LNR	0.6 km north	Yes	No	- Woodland, scrub and wet grassland - Plants including pyramidal and southern marsh orchids, grey club rush and wild basil
Stave Hill Ecology Park LNR	0.5km south	Yes	No	- Grassland, woodland, scrub and wetland habitats
Brookmill Road LNR	1.65km south	Yes	No	- Woodland, grassland and pond habitats - Flowers including cowslip and marjoram - Frogs and smooth newts - Birds including blackcap, long tailed tit and lesser white throat
Scrattons Ecopark and Extension LNR	1.26km north	Yes	No	- Grassland, woodland and dredged drainage ditches

Lavender Pond LNR

Lavender Pond is a local nature reserve comprising a disused reservoir that was originally used to maintain water levels in the Surrey Docks. The site supports reed beds, open water and islands that support invertebrate communities including damselflies.

Russia Dock Woodland LNR

The LNR comprises a mixture of habitats, including ponds and woodland. the site was created on site of the former Surrey Docks in the 1980's.

Mudchute Park Farm LNR

Mudchute Park Farm is made up of grazing pastures, wildflower banks, woodland, hedgerows, ponds and wetlands.

Tower Hamlets Cemetery Park LNR

A 19th Century cemetery with ancient broadleaved woods and created glades sown with wildflowers. Outstanding variety of plants and animals. The site supports 25 butterfly species and approximately 40 bird species. In 1992 three ponds were created that support aquatic invertebrates.

Ackroyd Drive Greenlink LNR

The site provides a green corridor between adjacent greenspaces and contains woodland and grassland habitats that support bird and invertebrate communities.

Sue Godfrey Nature Park LNR

The site contains a mixture of rough grassland, scrub and ruderal vegetation which support over 200 species of wildflowers, shrubs and trees.

Gilbert's Pit (Charlton) SSSI and Maryon Wilson Park & Gilbert's Pit LNR

Gilbert's Pit provides one of the most complete sections through the Lower Tertiary beds in the Greater London area. It forms a key Tertiary site for stratigraphic studies and is particularly important for a palaeogeographic reconstruction of the Woolwich and Reading Beds.

Maryon Park and Gilbert's Pit have a mix of acid grassland, that support a good assemblage of burrowing hymenoptera (bees and wasps), in addition to scrub, and secondary woodland.

Crossness LNR

The site supports a network of ditches and open water, scrub and rough grassland. The reserve is a water vole stronghold, and over 130 different species of bird have been recorded at Crossness Nature Reserve. The site information identifies that's number of rare aquatic and terrestrial invertebrates are present, as well as some important flora species.

Ripple LNR

The site comprises woodland, scrub and wet grassland. The dumping of fly ash has created a soil that is very alkaline and therefore different to most soils in London. The grasslands support Pyramidal and southern marsh orchids (*Dactylorhiza praetermissa*), grey club rush (*Schoenoplectus tabernaemontani*) and wild basil (*Clinopodium vulgare*).

Stave Hill Ecology Park LNR

This site is located to the south of the Thames Tideway, in Canada Water. The site is managed by volunteers and has been designed to form a mosaic of grassland, woodland, scrub and wetland habitats which support a variety of wildlife.

Brookmill Road LNR

This site is located to the south of the Thames Tideway, just north of Lewisham. The site includes woodland, grassland and pond habitats and supports a variety of wildlife including the flowers cowslip (*Primula veris*) and marjoram (*Origanum majorana*), frogs, smooth newts (*Lissotriton vulgaris*), and the birds blackcap (*Sylvia atricapilla*), long tailed tit (*Aegithalos caudatus*) and lesser white throat (*Curruca curruca*).

Scrattons Ecopark and Extension LNR

This site is located to the north of the Thames Tideway to the northeast of Barking Riverside. Former marshland and allotments with areas of planted woodland, grassland and wildflowers which supports a variety of wildlife.

2.9.4 Freshwater Lee Diversion Channel

Reach G - Newman's Weir on the Enfield Island Loop to Chingford abstractions

Four designated sites were identified within 2 km of Reach G: Chingford Reservoirs SSSI, Epping Forest SSSI, Epping Forest SAC, and Ainslie wood LNR. The location of designated sites relative to Reach G and presence of water dependent features is identified in Table 2-32.

The Epping Forest SSSI is contiguous with the Epping Forest SAC. The potential impacts to the qualifying features of the Epping Forest SAC are presented in the London Effluent Reuse SRO Habitat Regulations Assessment (Annex B.3).

Table 2-32 Designated sites within 2km of Reach G

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
Chingford Reservoirs SSSI	0 km - west	Yes	Yes	- Wintering wildfowl and wetland birds including great crested grebe, shoveler, goldeneye, tufted duck and goosander
Epping Forest SSSI	0.29 km east	Yes	No	- Atlantic acidophilous beech forest with holly and yew in shrub layer - Northern Atlantic wet heaths and European dry heath - Populations of stag beetle and other saproxylic invertebrate species
Epping Forest SAC	0.29 km east	Yes	No	- Atlantic acidophilous beech forest with holly and yew in shrub layer - Northern Atlantic wet heaths and European dry heath

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
				- Populations of stag beetle and other saproxylic invertebrate species
Ainslie wood LNR	1.48 km south - east	Yes	No	- Deciduous woodland - Bird communities

Chingford reservoirs SSSI

The two Chingford Reservoirs (King George V and William Girling) have been designated as a SSSI as they are one of the major wintering grounds for wildfowl and wetland birds in the London area. The SSSI is notified for the following interest features:

- Wintering great crested grebe (*Podiceps cristatus*); and
- Wintering shoveler (*Anas clypeata*).

Other wildfowl that winter on the reservoirs in important numbers include goldeneye (*Bucephala clangula*), tufted duck (*Aythya fuligula*) and goosander (*Mergus merganser*) with populations of the latter two occasionally reaching levels of national significance. The reservoirs also support one of London’s principal gull roosts with combined counts of 70,000 black-headed gull (*Chroicocephalus ridibundus*), common gull (*Larus canus*), lesser black-backed gull (*Larus fuscus*) and herring gull (*Larus argentatus*).

The reservoirs are noted in the London area as a site for migrant wetland birds on spring and autumn passage and they form a moult refuge for large populations of wildfowl during the late summer months.

In addition, part of the Flood Relief Channel to the east of the reservoirs has been designated because of its importance as feeding habitat for goosander, a fish-eating species, as a result of their habit for feeding in the concrete lined Flood Relief Channel along the eastern margin of the reservoir embankments.

Based on condition assessment by Natural England in 2012 all management units of the site are in unfavourable recovering condition This is attributed to the low shoveler population on the site. This is not influenced by site management and could be attributed to background population trends or alternative site preference.

Epping Forest SSSI and SAC

The site of interest for Atlantic acidophilous beech forests with holly (*Ilex aquifolium*) and sometimes also yew *Taxus* sp. in the shrub layer (*Quercion robori-petraeae* or *Ilici-Fagenion*), areas of Northern Atlantic wet heaths with *Erica tetralix*, European dry heath, and the populations of stag beetle and other saproxylic invertebrate species.

Ainslie Wood LNR

The LNR comprises deciduous woodland with a variety of tree species including the wild service tree (*Sorbus torminalis*). The woodland supports varied bird and communities.

Reach H - Chingford abstractions to Three Mills Lock

Eight designated sites were identified within 2 km of Reach H: Walthamstow Reservoirs SSSI, Walthamstow Marshes SSSI, Walthamstow Marshes NNR, Springfield Park LNR, Ainslie Wood LNR, Lee Valley SPA, Lee Valley Ramsar and Abney Park Cemetery LNR. The location of designated sites relative to Reach H and presence of water dependent features is identified in Table 2-33.

The Walthamstow Reservoirs SSSI is a constituent component of the Lee Valley SPA and Lee Valley Ramsar site. The potential impacts to the Lee valley SPA and Ramsar are presented in the London Effluent Reuse SRO Habitat Regulations Assessment (Annex B.3).

Table 2-33 Designated sites within 2km of Reach H

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
Walthamstow Reservoirs SSSI	0 km - borders river Lee	Yes	Yes	- Breeding birds, wintering wildfowl and wetland birds - Heronry of national importance - Post-breeding refuge for tufted duck
Walthamstow Marshes SSSI	0 km - borders river Lee	Yes	Yes	- Semi-natural wetland - Invertebrate assemblage - Neutral grassland, sedge marsh, reed swamp and willow scrub habitats
Walthamstow Marshes NNR	0 km - borders river Lee	Yes	Yes	- Semi-natural wetland - Invertebrate assemblage - Neutral grassland, sedge marsh, reed swamp and willow scrub habitats
Springfield Park LNR	0.01 km west	No	No	- Wood pasture and deciduous woodland
Ainslie Wood LNR	1.45 km east	Yes	No	- Deciduous woodland - Bird communities
Lee Valley SPA	0 km - borders river Lee	Yes	Yes	- Birds including bittern, shoveler, gadwall, cormorant, great crested grebe, tufted duck, pochard and grey heron
Lee Valley Ramsar	0 km - borders river Lee	Yes	Yes	- Birds including bittern, shoveler, gadwall, cormorant, great crested grebe, tufted duck, pochard and grey heron
Abney Park Cemetery LNR	1.39 km south west	No	No	- Arboretum providing habitat for birds, insects and fungi

Walthamstow Reservoirs SSSI

The Walthamstow Reservoirs SSSI contains one of the country’s major heronries and a particularly large concentration of breeding wildfowl. They are also an important gathering area for moulting tufted duck and in winter attract nationally significant populations of wildfowl and other wetland birds. The SSSI covers an area of 178.3 ha. (440.6 ac.).

The Walthamstow Reservoirs SSSI Site is entirely contiguous with the Lee Valley Ramsar and thus the Lee Valley SPA sites (both covering an area of 447.87 ha).

The SSSI is notified for the following interest features:

- Heronry of national importance
- A major post-breeding refuge for tufted duck
- Breeding populations of national significance. Overwintering of the following wetland bird species:
 - Great crested grebe (*Podiceps cristatus*),
 - Pochard (*Anythya farina*),
 - Tufted duck (*Aythya fuligula*),
 - Coot (*Fulica atra*),
 - Yellow wagtail (*Motacilla flava*),
 - Sedge and reed warblers (*Acrocephalus* spp.).
- Overwintering grounds for nationally significant populations of cormorant, tufted duck (*Aythya fuligula*) and shoveler (*Anas clypeata*).

- 300 plus species of plant recorded from the site, including:
 - Marsh-marigold (*Caltha palustris*),
 - Hybrid “graceful” sedge (*Carex x subgracilis*),
 - Common club-rush (*Schoenoplectus lacustris*),
 - Lesser bulrush (*Typha angustifolia*).

Based on the latest monitoring data from Natural England the entire site has been assessed as being in an unfavourable recovering condition.

Walthamstow Marshes SSSI and NNR

Walthamstow Marshes are one of the last remaining examples of semi-natural wetland in Greater London. They contain a variety of plant communities typical of a former flood plain location, such as a range of neutral grassland types, sedge marsh, reed swamp, willow scrub and areas of tall herb vegetation. Associated with this diversity of habitat are several species of plant and insect, which are uncommon in the London area.

The SSSI is notified for the following interest features:

- Invertebrate assemblage – notably the Essex skipper butterfly (*Thymelicus lineola*), an uncommon hoverfly (*Volucella inanis*) and marshland species such as a pyralid moth (*Shoeribus micronellus*) and Roesel’s bush cricket (*Metrioptera roeselii*).
- M27 - Mire (*Filipendula ulmaria* - *Angelica sylvestris*),
- S28 - tall-herb fen (*Phalaris arundinacea*),
- S4 - Swamp and reed-beds (*Phragmites australis*),
- S5 - Swamp (*Glyceria maxima*),
- S7 - Swamp (*Carex acutiformis*),
- W1 - Woodland (*Salix cinerea* - *Galium palustre*).

Based on the latest monitoring data from Natural England the site has been assessed as being predominantly in an unfavourable declining condition, although a small proportion (i.e. Unit 003, Horseshoe Point which contains broadleaves, mixed and yew woodland, covering 7.6% of the marshes’ area) is in favourable condition. The unfavourable condition is a result of dense litter/thatch cover, a lack of positive indicator species and the cover of undesirable non-woody species.

Springfield Park LNR

Formed from the grounds of three private houses, of which only Springfield House (The White House) remains. The Park is around 40 acres in size, with formalised gardens and conservation. There is limited information available on why the site is designated but the priority habitats inventory identifies that the site predominantly comprises wood pasture with areas of deciduous woodland.

Ainslie wood LNR

The designated features of the sites are described in the Reach G assessment.

Abney park cemetery LNR

A collection of trees originally laid out around 1840 as a labelled tree collection. The tree collection and more recently developed woodland areas provide habitat for wildlife including birds, insects and fungi.

Reach I - Three Mills Lock to Thames Tideway

Two designated sites were identified within 2 km of Reach I: Ackroyd Drive LNR and Tower Hamlets Cemetery Park LNR. The location of designated sites relative to Reach I and presence of water dependent features is identified in Table 2-34.

The Walthamstow Reservoirs SSSI is a constituent component of the Lee Valley SPA and Lee Valley Ramsar site. The potential impacts to the Lee valley SPA and Ramsar are presented in the London Effluent Reuse SRO Habitat Regulations Assessment (Annex B.3).

Table 2-34 Designated sites within 2km of Reach I

Site Name	Distance from impacted reach	Water dependent features	Hydrological connectivity to impacted reach	Notable features
Ackroyd Drive Greenlink LNR	1.23 km - borders river Lee	No	No	- Ancient broadleaved woods, wildflowers and ponds - 40 bird species and 25 butterfly species
Tower Hamlets Cemetery Park LNR	1.08 km - borders river Lee	Yes	No	- Green corridor with woodland and grassland habitats - Bird and invertebrate communities

Tower Hamlets Cemetery Park LNR

A 19th Century cemetery with ancient broadleaved woods and created glades sown with wildflowers. Outstanding variety of plants and animals. The site supports 25 butterfly species and approximately 40 bird species. In 1992 three ponds were created that support aquatic invertebrates.

Ackroyd Drive Greenlink LNR

The site provides a green corridor between adjacent greenspaces and contains woodland and grassland habitats that support bird and invertebrate communities.

3. AQUATIC ECOLOGY ASSESSMENT OF BECKTON WATER RECYCLING SCHEME

3.1 INTRODUCTION

This section sets out the assessment for the tasks set out in Table 1-1 relevant to the Beckton water recycling scheme. The study area for each task has been set out per task as it is not consistent across tasks. The Beckton water recycling scheme assessment for each of the following tasks has been set out in the following sections:

- Aquatic Invertebrates freshwater– Section 3.2
- Aquatic Invertebrates estuarine – Section 3.3
- Marginal habitat assessment – Section 3.4
- Macrophytes – Section 3.5
- Diatoms – Section 3.6
- Macroalgae, Angiosperm and Phytoplankton – Section 3.7
- Designated and protected sites and species – Section 3.8

The data used for undertaking the assessments has been outlined in Table 1-1.

These assessments have been undertaken for the following for each task:

- Aquatic invertebrates across Reaches D, E and F in the estuarine Thames Tideway, Reaches G and H in the freshwater Lee Diversion Channel and Reach I in the estuarine River Lee
- Marginal habitats across Reach G in the freshwater Lee Diversion Channel
- Macrophytes across Reaches G and H in the freshwater Lee Diversion Channel
- Diatoms across Reaches Reach E in the estuarine Thames Tideway and Reaches G and H in the freshwater Lee Diversion Channel
- Macroalgae, Angiosperm and Phytoplankton across Reaches D, E and F in the estuarine Thames Tideway
- Designated and protected sites and species across Reaches D, E and F in the estuarine Thames Tideway, Reaches G and H in the freshwater Lee Diversion Channel and Reach I in the estuarine River Lee.

Where text makes reference to A82 and M96 flow series, respectively these refer to 1 in 5 year and 1 in 20-year flow events.

These assessments have been conducted utilising impact assessments determined within the Physical Environment⁴⁵ and Water Quality⁴⁶ Gate 2 Assessment Reports.

Summary of physical environment impacts associated with a Beckton water recycling Scheme

The full assessment of the Gate 2 physical environment impacts of the Beckton water recycling schemes includes an assessment of:

- Velocity and flow,
- Outfall design,
- Wetted habitat,
- Fish pass and barrier passability, and
- Estuarine sediment.

Table 3-1 shows a high-level summary of these impacts, which are also briefly described as follows.

⁴⁵ Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Physical Environment Assessment Report.

⁴⁶ Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Water Quality Assessment Report.

Velocity and flow

The Beckton water recycling scheme is expected to result in major impacts (all scheme sizes) to flow conditions within the Lee Diversion Channel. These are described in the ~100m reach of heavily modified channel of the Enfield Island Loop between a Beckton water recycling outfall and the existing intake to King George V Reservoir. There may also be impacts in the remaining ~500m heavily modified reach of the Enfield Island Loop downstream to the confluence with the Lee Diversion Channel but the effects cannot be quantified as they are entirely dependent on the abstraction regime operated for the Thames Water intakes.

Outfall design

The potential impacts predicted for outfall design are negligible for all scheme sizes. While this was not set out in detail at Gate 2, the extent of flow increase, a 0.3m/s exit velocity and the shallow channel depth would result in full dispersal of plume within metres of the outfall in a heavily modified channel.

Wetted habitat

The potential impacts predicted for wetted habitat are moderate for the 300 MI/d scheme size, with ~60% increase in water width and ~120% increase in mean flow velocity in ~100m reach of heavily modified channel of the Enfield Island Loop at very low flow conditions modelled, unknown changes in wetted habitats and indiscernible changes in exposure of estuarine wetted habitat.

Fish pass and barrier passability

The potential impacts predicted for fish pass and barrier passability are negligible for all scheme sizes.

Estuarine sediment

The potential impacts predicted for estuarine sediment are negligible for all scheme sizes, with negligible changes in suspended solids concentration within the estuary.

Table 3-1 Summary of potential physical environment impacts for Beckton water recycling schemes

Size	Flow	Outfall design	Wetted habitat	Barrier passability	Estuarine sediment
100 MI/d	Major. 80% increase in very low flows(Q95) in ~100m reach of Enfield Island Loop, with 0-80% increase in flows downstream in ~500m reach of Enfield Island Loop and downstream Lee Diversion. Zero change beyond Flanders Weir.		Minor. ~20% increase in water width and ~40% increase in mean flow velocity in ~100m reach of heavily modified channel of the Enfield Island Loop at very low flow conditions. Unknown change downstream in a largely artificial channel without aquatic habitat. Indiscernible change in intertidal exposure in the estuarine Thames Tideway		
200 MI/d	Major. 160% increase in very low flows (Q95) in ~100m reach of Enfield Island Loop, with 0-160% increase in flows downstream in ~500m reach of Enfield Island Loop and downstream Lee Diversion. Zero change beyond Flanders Weir.	Negligible. Not set out in detail at Gate 2 but due to extent of flow increase, a 0.3m/s exit velocity and the shallow channel depth would result in full dispersal of plume within metres of the outfall in a heavily modified channel.	Moderate. ~40% increase in water width and ~80% increase in mean flow velocity in ~100m reach of heavily modified channel of the Enfield Island Loop at very low flow conditions. Unknown change downstream in a largely artificial channel without aquatic habitat. Indiscernible change in intertidal exposure in the estuarine Thames Tideway	Negligible. One low barrier, KGV North Weir, in the Enfield Island Loop with potential for increase in depth of water over crest and reduction in head difference both of which reduce any barrier effect.	Negligible. Negligible changes in suspended sediment concentration within the Thames Tideway from final effluent flow reductions at Beckton STW.
300 MI/d	Major. 240% increase in very low flows (Q95) in ~100m reach of Enfield Island Loop, with 0-240% increase in flows downstream in ~500m reach of Enfield Island Loop and downstream Lee Diversion. Zero change beyond Flanders Weir.		Moderate. ~60% increase in water width and ~120% increase in mean flow velocity in ~100m reach of heavily modified channel of the Enfield Island Loop at very low flow conditions. Unknown change downstream in a largely artificial channel without aquatic habitat. Indiscernible change in intertidal exposure in the estuarine Thames Tideway		

Summary of water quality impacts associated with a Beckton water recycling Scheme

The full assessment of the Gate 2 water quality impacts of the Beckton water recycling schemes includes an assessment of:

- Water temperature,
- General physico-chemical,
- WFD chemicals,
- Environmental Quality Standards Directive (EQSD) chemicals, and
- Olfactory water quality.

Table 3-2 shows a high-level summary of these impacts, which are also briefly described below.

Water temperature

Within the freshwater Lee Diversion Channel, over the annual period, the 98th percentile for the water temperature in 1 in 5-year (A82) moderate-low flow year scenario reduced by 0.2°C to 21.5°C and in the 1 in 20 (M96) very low flow year scenario the 98th percentile was reduced by 1.7°C to 20.0°C as a result of a 300 MI/d Beckton water recycling scheme.

The Thames Tideway modelling predicts no changes in temperature within the Thames Tideway associated with a Beckton water recycling scheme.

General physico-chemical

Within the freshwater Lee Diversion Channel, it is predicted that there may be minor positive changes in ammoniacal nitrogen and phosphorus within the 300 MI/d scheme size, comprising decreases in concentrations.

Dissolved oxygen saturation shows modelled minor positive changes with an increase in the annual 10th percentile in the 1 in 5 (A82) moderate-low flow year scenario from 113.1% to 114.1% and the annual 10th percentile in the 1 in 20 (M96) very low flow year scenario increasing from 113.1% to 116.5% as a result of a 300 MI/d Beckton water recycling scheme.

Within the estuarine Thames Tideway, it is predicted that there may be negligible changes to salinity, with maximum increases of 0.7 ppt. Dissolved inorganic nitrogen (DIN) decreases in concentration during scheme on periods, with reductions in concentration of up to 100 µMol/l.

WFD chemicals

Within the Thames Tideway negligible impacts are predicted with no further exceedance risk under the 100 MI/d scheme size (A82) and no further exceedances under the M96 scenario in the Thames Tideway.

Within the Thames Tideway negligible impacts are predicted with no further exceedance risk under the 200 MI/d scheme size (A82) and no further exceedances under the M96 scenario in the Thames Tideway.

Within the Thames Tideway negligible impacts are predicted with a maximum of 1 additional chemical (dissolved mercury) at risk of exceeding the standard and no further exceedance risk (respectively) under the 300 MI/d scheme size (A82) and no further risks of exceedance under the M96 scenario within the Thames Tideway.

EQSD chemicals

Within the Thames Tideway negligible impacts are predicted with one additional chemical (pirimicarb) at risk of exceeding the standard under the 100 MI/d scheme size under A82 and under M96.

Within the Thames Tideway negligible impacts are predicted with one additional chemical (pirimicarb) at risk of exceeding the standard under the 200 MI/d scheme size under A82 and under M96.

Within the Thames Tideway negligible impacts are predicted with one additional chemical (pirimicarb) at risk of exceeding the standard under the 300 MI/d scheme size under A82 and under M96.

Olfactory water quality

Within both the freshwater Lee Diversion Channel and upper Thames Tideway negligible impacts are predicted with three and one additional exceedance risks occurring from the reference conditions for A82 and M96 respectively under the 300 MI/d scheme size.

Table 3-2 Summary of potential water quality impacts for Beckton water recycling schemes

Size	Water temperature	General physico-chemical	WFD chemicals	EQSD chemicals	Olfactory water quality
100 MI/d	<p><u>Freshwater Lee</u> Negligible change in water temperature.</p> <p><u>Estuarine Thames</u> No change.</p>	<p><u>Freshwater Lee</u> Dissolved oxygen: No deterioration. No other data available</p> <p><u>Thames Tideway</u> Dissolved oxygen: No data available DIN: Reductions in DIN during scheme on Salinity: Negligible salinity increases inferred from larger schemes modelling.</p>	<p><u>Thames Tideway</u> 14 WFD chemicals exceeded the standard in the baseline scenario. With the scheme in operation (A82) no further chemicals exceeded the standard. Under the M96 scenario no further chemicals exceeded the standard.</p>	<p><u>Thames Tideway</u> With the scheme in operation (A82), one further chemical exceeded the standard. Under the M96 scenario one further chemical exceeded the standard.</p>	<p>Negligible Olfactory water quality inferred from larger schemes modelling.</p>
200 MI/d	<p><u>Freshwater Lee</u> Negligible change in water temperature.</p> <p><u>Estuarine Thames</u> No change.</p>	<p><u>Freshwater Lee</u> Dissolved oxygen: No deterioration. No other data available.</p> <p><u>Thames Tideway</u> Dissolved oxygen: No data available DIN: Reductions in DIN during scheme on Salinity: Negligible salinity increases inferred from larger schemes modelling.</p>	<p><u>Thames Tideway</u> 14 WFD chemicals exceeded the standard in the baseline scenario. With the scheme in operation (A82), no further chemicals exceeded the standard. Under the M96 scenario no further chemicals exceeded the standard.</p>	<p><u>Thames Tideway</u> With the scheme in operation (A82), one further chemical exceeded the standard. Under the M96 scenario one further chemical exceeded the standard.</p>	<p>Negligible Olfactory water quality inferred from larger schemes modelling.</p>
300 MI/d	<p><u>Freshwater Lee</u> Negligible change in water temperature.</p> <p><u>Estuarine Thames</u> No change.</p>	<p><u>Freshwater Lee</u> Dissolved oxygen: No deterioration. Ammonia: No deterioration. Phosphate:</p>	<p><u>Thames Tideway</u> 14 WFD chemicals exceeded the standard in the baseline scenario.</p>	<p><u>Thames Tideway</u> With the scheme in operation (A82), one further chemical exceeded the standard.</p>	<p><u>Freshwater Lee</u> A82 has three new pressures. M96 has two new pressures.</p> <p><u>Thames Tideway</u> A82 has one new pressure.</p>

Size	Water temperature	General physico-chemical	WFD chemicals	EQSD chemicals	Olfactory water quality
		<p>No deterioration.</p> <p>Langelier Saturation Index: Corrosive value not advisable.</p> <p><u>Thames Tideway</u></p> <p>Dissolved oxygen: No data available</p> <p>DIN: Reductions in DIN during scheme on</p> <p>Salinity: Negligible salinity increases inferred from larger schemes modelling.</p>	<p>With the scheme in operation (A82), one further chemical exceeded the standard.</p> <p>Under the M96 scenario no further chemicals exceeded the standard.</p>	<p>Under the M96 scenario one further chemical exceeded the standard.</p>	<p>M96 exhibits the same changes as for A82.</p>

3.2 AQUATIC INVERTEBRATES FRESHWATER

3.2.1 Overview

This section sets out the assessment for the freshwater aquatic invertebrates in reaches potentially affected by the Beckton water recycling scheme.

- Freshwater Lee Diversion Channel - Section 3.2.2

3.2.2 Freshwater Lee Diversion Channel

Table 3-1 summarises the potential physical environment impacts for each Beckton water recycling scheme volume scenarios.

Table 3-2 summarises the potential water quality impacts for each Beckton water recycling scheme volume scenarios.

Reach G – Newmans Weir on the Enfield Island Loop to Chingford Abstractions

Velocity and flow impacts upon the invertebrate community

Localised increases in flows immediately adjacent to the discharge outfall may exceed the tolerance range of several species found within the reach. Overall increased flows have the potential to increase the fitness and available habitat for species with a preference or tolerance to faster flows. With limited details of the outfall design currently, in depth analysis of effects of the increased velocity of from the outfall is not possible.

Increases in wetted width during low flow conditions may increase available habitat within the channel, providing opportunity for larger populations of invertebrates. As noted in the physical environment report, much of this increase in wetted width would be within the artificial channel, so may provide limited availability to most aquatic species.

Temperature impacts upon the invertebrate community

No negative impacts on temperature are expected within this reach, therefore no adverse impacts on the invertebrate community are expected. The tolerable range of the species within the reach are broad, and negligible changes are not likely to exceed these.

Oxygen Saturation impacts upon the invertebrate community

No negative impact on oxygen saturation within the freshwater Lee Diversion Channel is expected under any scenario, therefore no adverse impacts on the invertebrate community are expected.

Phosphorus impacts upon the invertebrate community

No significant negative changes in phosphorous are expected, therefore no adverse impacts on the invertebrate community are expected as many species within the reach are able to tolerate a wide range of nutrient levels within the freshwater Lee Diversion Channel.

Reach H – Chingford Abstractions to Three Mills Lock

There is a possibility that temperature decreases of up to 1.7°C such as those predicted above may potentially impact the tolerable range of any of the species found within the reach. However, there is a small chance of adverse impacts on the invertebrate community.

Velocity and flow impacts upon the invertebrate community

The flow impacts described above for Reach G are only expected to persist until Flanders weir, which is located at the very top of Reach H above Banbury Reservoir, beyond this there are no changes to flows in this reach.

Temperature impacts upon the invertebrate community

Impacts are not considered to deviate from those described in Reach G above.

Oxygen Saturation impacts upon the invertebrate community

Impacts are not considered to deviate from those described in Reach G above.

Phosphorus impacts upon the invertebrate community

Impacts are not considered to deviate from those described in Reach G above.

3.3 AQUATIC INVERTEBRATES ESTUARINE

3.3.1 Overview

This section sets out the assessment for the estuarine aquatic invertebrates in reaches potentially affected by the Beckton water recycling scheme.

- Estuarine Thames Tideway - Section 3.3.2
- Estuarine River Lee – Section 3.3.3

3.3.2 Estuarine Thames Tideway

Table 3-1 summarises the potential physical environment impacts for each Beckton water recycling scheme volume scenarios.

Table 3-2 summarises the potential water quality impacts for each Beckton water recycling scheme volume scenarios.

Reach D – Teddington Weir to Battersea Park

Velocity and flow impacts upon the invertebrate community

No change to velocity for flow in the middle Thames Tideway is expected as a result of reduced discharge from Beckton STW discharge.

Temperature impacts upon the invertebrate community

No impact is expected on temperature in the middle Thames Tideway as a result of reduced discharge from Beckton STW discharge.

Dissolved oxygen impacts upon the invertebrate community

No impact is expected on oxygen saturation in the middle Thames Tideway as a result of reduced discharge from Beckton STW discharge.

Dissolved inorganic nitrogen impacts upon the invertebrate community

Significant decreases in DIN are predicted for the Thames Tideway, this is not expected to impact the invertebrate community as the community has been determined to be tolerant to a wide range of nutrient conditions.

Reach E – Battersea Park to Tower Bridge

There are no invertebrate data available to make an assessment on aquatic invertebrates in Reach E. However, no physical environment or water quality impacts are expected within this Reach, and it is therefore considered that there would be no impacts to the invertebrate community.

Reach F Tower Bridge to 3km seawards of Beckton STW

There are no invertebrate data available to make an assessment on aquatic invertebrates in Reach F. However, no physical environment or water quality impacts are expected within this Reach, and it is therefore considered that there would be no impacts to the invertebrate community.

3.3.3 Estuarine River Lee

Table 3-1 summarises the potential physical environment impacts for each Beckton water recycling scheme volume scenarios.

Table 3-2 summarises the potential water quality impacts for each Beckton water recycling scheme volume scenarios.

Reach I – Three Mills Lock to Thames Tideway

There are no invertebrate data available to make an assessment on aquatic invertebrates in Reach I. However, no physical environment or water quality impacts are expected within this Reach, and it is therefore considered that there would be no impacts to the invertebrate community.

3.4 MARGINAL HABITAT ASSESSMENT

3.4.1 Overview

This section sets out the assessment for the marginal habitats in reaches potentially affected by the Beckton water recycling scheme.

- Freshwater Lee Diversion Channel - Section 3.4.2

The assessment on impacts to the RCA are based on outputs from the physical environment assessment report⁴⁷, INNS Report⁴⁸, and macrophyte assessment (Section 3.5).

In summary, there is a predicted major increase in very low flows (240%) in the ~100m reach, with zero change beyond Flanders Weir. There is also a predicted moderate (60%) increase in water width in the ~100m reach. Increased in wetted width during low flow conditions may increase available habitat within the channel, providing opportunity for larger populations of INNS and reduce chance of desiccation of certain INNS. A full summary of predicted physical environment impacts is detailed in Section 3.1, Table 3-1.

3.4.2 Freshwater Lee Diversion Channel

Reach G – Newmans Weir on the Enfield Island Loop to Chingford Abstractions

TR_09 covers a 660m reach upstream of the outfall to the reconnection with the Lee Diversion Channel. River condition indicator (see Table 3-3 for the full list) E3, channel bed hydraulic features, was assessed to increase in the section of the river covered by TR_09 in this reach due to the intake and discharge points which has been shown to alter flow patterns, introducing more diversity of flow immediately within the 100m section. Indicators C10 and E11 have been assessed to alter for TR_09 to reflect the outcome of the INNS assessment. Although there will be the addition of artificial bank face structures (intake and outfall structures) within the section of the river covered by TR_09, indicators C7-C9 were assessed to be no change as the bank face in these locations are already highly modified channels. Siltation of the channel bed (E7) was also predicted to increase during operation of this scheme.

The assessed changes to the indicator scores were both positive (increased hydraulic feature richness) and negative (increased siltation and NNIPS extent). Overall, the preliminary condition score was reduced to -0.660, however this change does not meet the lower threshold and the condition category for Poor, and therefore remains Fairly Poor river condition category.

⁴⁷ Ricardo Energy & Environment. (2022). *London Effluent Reuse SRO. Aquatic Physical Environment Assessment Report Draft 2.0*. Ref. 4700399659. Ricardo ref. ED13591.

⁴⁸ Ricardo Energy & Environment. (2022). *London Effluent Reuse SRO. INNS Assessment Report Draft 1.0*. Ref. 4700399659. Ricardo ref. ED13591.

Table 3-3 Assessed changes in river condition indicators of Reach G during operation of a 300 Ml/d Beckton water recycling scheme. Green shading indicates a positive change (i.e., a higher positive score or a lower negative score), and red shading indicates a negative change (i.e., a lower positive score or a higher negative score). '-' in the operational column indicates no change to the baseline score

Code	Indicator name	Positive / Negative type	TR_09 baseline	TR_09 operational
B1	Bank top vegetation structure	Positive	2	-
B2	Bank top tree feature richness	Positive	1	-
B3	Bank top water related features	Positive	0	-
B4	Bank top NNIPS cover	Negative	0	-
B5	Bank top managed ground cover	Negative	-4	-
C1	Bank face riparian vegetation structure	Positive	2	-
C2	Bank face tree feature richness	Positive	1	-
C3	Bank face natural bank profile extent	Positive	1	-
C4	Bank face natural bank profile richness	Positive	3	-
C5	Bank face natural bank material richness	Positive	1	-
C6	Bank face bare sediment extent	Positive	1	-
C7	Bank face artificial bank profile extent	Negative	-4	-
C8	Bank face reinforcement extent	Negative	-4	-
C9	Bank face reinforcement material severity	Negative	-4	-
C10	Bank face NNIPS cover	Negative	0	-1
D1	Channel margin aquatic vegetation extent	Positive	1	-
D2	Channel margin aquatic morphotype richness	Positive	1	-
D3	Channel margin physical feature extent	Positive	1	-
D4	Channel margin physical feature richness	Positive	1	-
D5	Channel margin artificial features	Negative	-1	-
E1	Channel bed aquatic morphotype richness	Positive	2	-
E2	Channel bed tree features richness	Positive	2	-
E3	Channel bed hydraulic features richness	Positive	0	1

Code	Indicator name	Positive / Negative type	TR_09 baseline	TR_09 operational
E4	Channel bed natural features extent	Positive	0	-
E5	Channel bed natural features richness	Positive	0	-
E6	Channel bed material richness	Positive	3	-
E7	Channel bed siltation	Negative	0	-1
E8	Channel bed reinforcement extent	Negative	0	-
E9	Channel bed reinforcement severity	Negative	0	-
E10	Channel bed artificial features severity	Negative	-2	-
E11	Channel bed NNIPS extent	Negative	0	-1
E12	Channel bed filamentous algae extent	Negative	-3	-
Preliminary condition score:			-0.482	-0.660
River condition category:			Fairly Poor	Fairly Poor

3.5 MACROPHYTES

3.5.1 Overview

This section sets out the assessment for the macrophyte communities in reaches potentially affected by the Beckton water recycling scheme.

- Freshwater Lee Diversion Channel – Section 3.5.2

3.5.2 Freshwater Lee Diversion Channel

Reach G - Newmans Weir on the Enfield Island Loop to Chingford Abstractions

Velocity and flow impacts upon the macrophyte community

Major increases in very low flows are predicted within the 100m reach of Enfield Island Loop, which may have the potential to increase the number of macrophyte species present within the reach, which is currently classified as poor. Further decreases in flow may have little impact on the macrophyte community in this reach, which currently already have preferences for slower waters. The increase in wetted widths could result in a loss of some marginal habitat that will be preferred by macrophyte groups with a preference for slow flowing water (taxa with high RMHI scores). The increase in wetted width could also reduce habitat availability for marginal macrophyte species, although this will provide additional habitat for macrophytes with a preference for fast flowing water.

Therefore, the likely increasing in velocities and flow as a result of the schemes may change the overall community structure with Reach G with an increase in taxa with a preference for faster flowing water.

Temperature impacts upon the macrophyte community

There is a possibility of temperature decreases of up to 1.7°C, such as those predicted above, may have negative impacts on macrophyte communities. As it is possible that by decreasing temperature, there will be an increase in optimum conditions for macrophyte species.

The results of the water quality modelling indicate that changes are expected to be minimal for temperature. Therefore, no significant impacts are anticipated on the macrophyte communities.

Oxygen Saturation impacts upon the macrophyte community

Minor positive changes in dissolved oxygen could be seen within the reach, which could be beneficial for some macrophyte species that are near the lower end of their tolerance. No negative impacts on dissolved oxygen saturation are expected within this reach, therefore no adverse impacts on the macrophyte community are expected.

Phosphorus impacts upon the macrophyte community

Minor decreases in phosphorous concentrations which could be beneficial for some macrophyte species within the reach. No negative impacts on phosphorous concentration are expected within this reach, therefore no adverse impacts on the macrophyte community are expected.

Reach H - Chingford Abstractions to Three Mills Lock

Velocity and flow impacts upon the macrophyte community

The flow impacts described above for Reach G are only expected to persist until Flanders weir, which is located at the very top of Reach H above Banbury Reservoir, beyond this there are no changes to flows in this reach.

Temperature impacts upon the macrophyte community

Impacts are not considered to deviate from those described in Reach G above.

Oxygen Saturation impacts upon the macrophyte community

Impacts are not considered to deviate from those described in Reach G above.

Phosphorus impacts upon the macrophyte community

Impacts are not considered to deviate from those described in Reach G above.

3.6 DIATOMS

3.6.1 Overview

This section sets out the assessment for the diatoms in reaches potentially affected by the Beckton water recycling scheme.

- Freshwater Lee Diversion Channel – Section 3.6.2
- Estuarine Thames Tideway - Section 3.6.3

3.6.2 Freshwater Lee Diversion Channel

Table 3-1 summarises the potential physical environment impacts for each Beckton water recycling scheme volume scenarios.

Table 3-2 summarises the potential water quality impacts for each Beckton water recycling scheme volume scenarios.

Reach G - Newmans Weir on the Enfield Island Loop to Chingford Abstractions

Velocity and flow impacts upon the diatom community

Major increases in very low flows are predicted in ~100m reach of Enfield Island Loop, while this may have the potential to increase the fitness and available habitat for species with high motility as with higher motility, diatoms will be able to find and seek refuge in new habitats along the reach, the motility scores for the diatoms in this reach are low.

All benthic diatom taxa are divided into three diatom ecological guilds based on growth morphologies and their ability to tolerate nutrient limitation and physical disturbance, i.e., low-profile, high-profile, and motile guilds⁴⁹⁵⁰. The low-profile guild comprises diatom taxa of short stature that are predominantly attached to substrate. Diatom taxa belonging to the high-profile guild are larger or tend to form long colonies or stalks. The motile guild comprises comparatively fast-moving species. Diatoms with high motility are able to move with flows, whereas those with low motility cannot. The low-profile guild are known to dominate at high current velocities, whereas the high-profile guild prevails in low velocities resulting in low guild diversity at both ends of the current velocity gradient.

This reach, therefore, has the potential to have an adverse impact on those diatom communities with little motility. From the samples collected within this reach, the results showed that there was a low percentage of motile diatoms present, with an average of 17.45% in LRUS-16. Therefore, diatoms in this reach are likely to be affected in areas where there is an increase in flows.

Temperature impacts upon the diatom community

One of the most substantial ecological factors of rivers is temperature as species have evolved to exist in specific temperatures⁵¹. Diatom communities are considered to react to changes in environmental factors far quicker than larger communities such as invertebrates¹. It is suggested that diatom communities are negatively affected by changes in thermal regime with high-profile taxa being reduced by changes in temperature and flow from reservoir releases¹. Literature associated with changes in diatom communities is rare however a lab-based study in 1989 found that short-term changes in thermal regime significantly reduced high-profile taxa⁵².

There is a possibility that temperature decreases by up to 1.7°C such as those predicted above may potentially decrease the fitness of individual diatom species. Conversely, a decrease in temperature also may have positive impacts on diatom communities. It is possible that by decreasing the temperature, there will be an increase in optimum conditions for diatom species. Decreasing temperatures have also been found to

⁴⁹ Passy, S. (2007). Diatom ecological guilds display distinct and predictable behaviour along nutrient and disturbance gradients in running waters. *Aquatic Botany*, 86, 171-178. [10.1016/j.aquabot.2006.09.018](https://doi.org/10.1016/j.aquabot.2006.09.018).

⁵⁰ Rimet, F., Bouchez, A. (2012). Life-forms, cell-sizes and ecological guilds of diatoms in European rivers. *Knowledge and Management of Aquatic Ecosystems*, 406, 1–12. <https://doi.org/10.1051/kmae/2012018>.

⁵¹ Hussain, Q.A., 2012. Invertebrates in streams: A review of some ecological factors. *International Journal of Fisheries and Aquaculture*, 4(7), pp.114-123.

⁵² Blinn, D. W., Truitt, R., & Pickart, A. (1989). Response of epiphytic diatom communities from the tailwaters of Glen Canyon Dam, Arizona, to elevated water temperature. *Regulated Rivers: Research & Management*, 4(1), 91-96.

accelerate division rates within diatom species when lower tolerances have been reached. Therefore, those diatom species with a lower temperature tolerance may thrive.

Oxygen Saturation impacts upon the diatom community

No negative impacts on dissolved oxygen saturation are expected within this reach, therefore no adverse impacts on the diatom community are expected.

Phosphorus impacts upon the diatom community

No negative impacts on dissolved oxygen saturation are expected within this reach, therefore no adverse impacts on the diatom community are expected.

Reach H - Chingford Abstractions to Three Mills Lock

Velocity and flow impacts upon the diatom community

The flow impacts described above for Reach G are only expected to persist until Flanders weir, which is located at the very top of Reach H above Banbury Reservoir, beyond this there are no changes to flows in this reach.

Temperature impacts upon the diatom community

Impacts are not considered to deviate from those described in Reach G above.

Oxygen Saturation impacts upon the diatom community

Impacts are not considered to deviate from those described in Reach G above.

Phosphorus impacts upon the diatom community

Impacts are not considered to deviate from those described in Reach G above.

3.6.3 Estuarine Thames Tideway

Table 3-1 summarises the potential physical environment impacts for each Beckton water recycling scheme volume scenarios.

Table 3-2 summarises the potential water quality impacts for each Beckton water recycling scheme volume scenarios.

Reach D – Teddington Weir to Battersea Park

There are no data available to make an assessment on diatoms within Reach D.

Reach E – Battersea Park to Tower Bridge

Velocity and flow impacts upon the diatom community

No impacts on flow or velocity are expected within this reach.

Temperature impacts upon the diatom community

No impacts on temperature are expected within this reach.

Dissolved oxygen impacts upon the diatom community

The data was not available to complete the assessment for dissolved oxygen concentration in the Thames Tideway.

Dissolved inorganic nitrogen impacts upon the diatom community

Significant decreases in DIN are predicted for the Thames Tideway, this is not expected to impact the diatom community as the community has been determined to be tolerant to a moderate to low organic pollution. However, the reduction in DIN may increase the presence of more sensitive diatom species during periods when the scheme is on.

3.7 MACROALGAE, ANGIOSPERM AND PHYTOPLANKTON

3.7.1 Overview

This section sets out the assessment for the macroalgae, angiosperm and phytoplankton in reaches potentially affected by the Beckton water recycling scheme. It should be noted that marine angiosperms are not present within the upper and middle Thames Tideway and that known beds are circa 45km down river of Beckton STW.

- Estuarine Thames Tideway - Section 3.7.2

3.7.2 Estuarine Thames Tideway

Table 3-1 summarises the potential physical environment impacts for each Beckton water recycling scheme volume scenarios.

Table 3-2 summarises the potential water quality impacts for each Beckton water recycling scheme volume scenarios.

Reach D – Teddington Weir to Battersea Park

Velocity and flow impacts upon the macroalgae and phytoplankton community

No impacts on flow or velocity are expected within this reach.

Temperature impacts upon the macroalgae and phytoplankton community

No impacts on temperature are expected within this reach.

Dissolved oxygen impacts upon the macroalgae and phytoplankton community

The data was not available to complete the assessment for dissolved oxygen concentration in the Thames Tideway.

Dissolved inorganic nitrogen impacts upon the macroalgae and phytoplankton community

Significant decreases in DIN are predicted for the Thames Tideway, this is not expected to negatively impact the macroalgal community as the community has been determined to be in an impacted state and the reduction in DIN may increase the presence of more sensitive species. It is also considered that a reduction in DIN will not negatively impact the phytoplankton community, which is in an unimpacted state, as DIN reductions are likely to increase the fitness of the community.

Reach E – Battersea Park to Tower Bridge

There are no data available to make an assessment on macroalgae or phytoplankton within Reach E.

Reach F Tower Bridge to 3km seawards of Beckton STW

There are no data available to make an assessment on macroalgae or phytoplankton within Reach F.

3.8 DESIGNATED AND PROTECTED SITES AND SPECIES

3.8.1 Overview

This section sets out the assessment for the designated and protected sites and species in reaches potentially affected by the Beckton water recycling scheme.

- Freshwater Lee Diversion Channel – Section 3.8.2
- Estuarine Thames Tideway – Section 3.8.3

3.8.2 Freshwater Lee Diversion Channel

Table 3-1 summarises the potential physical environment impacts for each Beckton water recycling scheme volume scenarios.

Table 3-2 summarises the potential water quality impacts for each Beckton water recycling scheme volume scenarios.

Chingford reservoirs SSSI

The existing operating regime and River Lee abstraction is designed to maintain water levels in the King George V and William Girling reservoirs, consequently there is no evidence to suggest that change in flow within the rivers would negatively affect the levels within the reservoirs. Increased flow in the watercourse and increased available volume for abstraction will have a positive effect on the ability to maintain reservoir levels under low flow conditions. The qualifying features of the SSSI are water birds that rely on open water bodies and their margins. Consequently, if there are no reduction in extent or quality of open water within the reservoirs there will be no negative impact on the features of interest for the SSSI.

The SSSI designation for the Lee Flood Relief Channel extends from Chingford Weir to just north of the Lea Valley Road, and again from immediately south of the Lea Valley Road to the southern end of William Girling Reservoir. There is no publicly available survey data to indicate which other species are present in the River Lee Diversion however it has been assumed that it has the potential to support any of the designated features.

The SSSI citation specifically references goosander, a fish-eating species, which are noted for their habit of feeding in the concrete lined River Lee Flood Relief Channel along the eastern margin of the reservoir embankments. The increase in flow within the watercourse due to the scheme is likely to increase resilience of fish communities under low flow conditions which would benefit goosander through increase resilience of prey resource.

Epping Forest SSSI and SAC

The site is located approximately 0.29 km east of the impacted reach of the River Lee. Epping Forest has hydrological connectivity to the impacted reach via the River Ching; a tributary of the River Lee Diversion. However, Epping Forest is upstream of the impacted reach so there is no potential for hydrological impacts due to changes in water levels, water quality, or aquatic invasive species therefore no adverse effects on the site are expected.

Ainslie Wood LNR

The LNR is located 1.4 km east of the freshwater Lee Diversion Channel with no hydrological connectivity from the impacted reach to the site. Therefore, due to the distance and absence of impact pathways potential impacts to the LNR are considered highly unlikely.

Walthamstow Reservoirs SSSI

The impacted reach of the freshwater Lee Diversion Channel is outside of the Walthamstow Reservoir SSSI boundary.

There are no flow changes in the reach of the freshwater Lee Diversion Channel adjacent to the site associated with a Beckton water recycling scheme, as any discharges that would increase flow in the upstream Lee Diversion Channel would be abstracted upstream of Walthamstow Reservoirs. In addition, no water quality impacts are anticipated in Lee Diversion Channel due to operation of the Beckton water recycling scheme. Therefore, no impacts to the qualifying features of the SSSI are anticipated due to changes in hydrology or water quality.

The transfer of water to the Lee Diversion Channel raises the potential for introduction of invasive non-native species to the Lee Diversion Channel due to water transfer/reuse discharge. Introduction of invasive non-native species would reduce the availability or quality of supporting habitats for qualifying species of the SSSI. Although the Lee Diversion Channel is outside of the Site boundary it is likely to provide supporting habitat for the qualifying features of the site. However, the INNS assessment (Annex B.2.5) concluded it is not likely that the introduction or transfer of INNS will occur within this scheme. As the effluent discharge is treated in several steps prior to discharge into the Lee Diversion Channel, all pathways that are likely to introduce or transfer INNS are eliminated during normal operation.

Walthamstow Marshes SSSI and NNR

Walthamstow Marshes is located south of Walthamstow Reservoir SSSI and is bordered by the River Lee/Lee Navigation of the western boundary of the SSSI. The impacted Lee Diversion Channel is not within the boundary of the Site. There is likely to be hydrological connectivity between the Lee Diversion Channel and wetland habitats that form Walthamstow Marshes, however, as there will be no change in flow or water level within the reach adjacent to the Site, no adverse impacts to the qualifying features of the site are anticipated.

There is potential for introduction of invasive non-native species to the Lee Diversion Channel due to water transfer/reuse discharge. Introduction of invasive non-native species could reduce the availability or quality of wetland habitats and supporting habitats for qualifying species of the SSSI. However, it is not likely that the introduction or transfer of INNS will occur from the Beckton water recycling scheme in the Lee Diversion Channel as the effluent discharge is treated in several steps prior to discharge. Therefore, all pathways that are likely to introduce or transfer INNS are eliminated during normal operation.

Springfield Park LNR

The Lee Diversion Channel forms the eastern boundary of the LNR. The impacted Lee Diversion Channel is not within the boundary of the Site. There will be no change in flow or water level within this area of the Lee Diversion Channel and consequently no potential for adverse impacts to the qualifying features of the site.

Ainslie Wood LNR

The LNR is located 1.48 km south-east of the Lee Diversion Channel with no hydrological connectivity from the Lee to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the Lee Diversion Channel for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Abney Park cemetery LNR

The LNR is located 1.39km south-west of the Lee Diversion Channel with no hydrological connectivity from the Lee Diversion Channel to the Site. Due to the distance and absence of both impact pathways and water dependent features, potential impacts to the LNR are considered highly unlikely.

Tower Hamlets Cemetery Park LNR

The LNR is located 1.08 km west of the Lee Diversion Channel with no hydrological connectivity from the Lee Diversion Channel to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the Lee for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Ackroyd Drive Greenlink LNR

The LNR is located 1.23 km west of the Lee Diversion Channel with no hydrological connectivity from the Lee Diversion Channel to the Site. Due to the distance and absence of both impact pathways and water dependent features, potential impacts to the LNR are considered highly unlikely.

A summary of potential impacts to the designated sites within 2km of the freshwater Lee Diversion Channel is shown in Table 3-4.

Table 3-4 Beckton water recycling designated site impact assessment summary for the freshwater Lee Diversion Channel

Site Name	Potential impacts	Further assessment required
Chingford reservoirs SSSI	No potential impacts identified	No
Epping Forest SSSI	No potential impacts identified	No
Epping Forest SAC	No potential impacts identified	No
Ainslie Wood LNR	No potential impacts identified	No
Walthamstow Reservoirs SSSI	No potential impacts identified	No
Walthamstow Marshes SSSI	No potential impacts identified	No
Walthamstow Marshes NNR	No potential impacts identified	No
Springfield Park LNR	No potential impacts identified	No
Ainslie wood LNR	No potential impacts identified	No
Abney park cemetery LNR	No potential impacts identified	No
Tower Hamlets Cemetery Park LNR	No potential impacts identified	No
Ackroyd Drive Greenlink LNR	No potential impacts identified	No

3.8.3 Estuarine Thames Tideway

Table 3-1 summarises the potential physical environment impacts for each Beckton water recycling scheme volume scenarios.

Table 3-2 summarises the potential water quality impacts for each Beckton water recycling scheme volume scenarios.

Bushy Park and Home Park SSSI

The SSSI is located only 0.03 km from the estuarine Thames Tideway however the site is not designated for water dependent features and is not reliant on the level, flow, or water quality of the freshwater Lee Diversion Channel for maintenance of site condition. Therefore, due to the absence of impact pathways, potential impacts to the SSSI are considered highly unlikely.

Richmond Park SSSI, NNR, and LNR

Richmond Park is located over 0.5 km from the estuarine Thames Tideway and is not designated for water dependent features. Therefore, it is not reliant on the level, flow, or water quality of the estuarine Thames Tideway for maintenance of site condition. Therefore, due to the absence of impact pathways, potential impacts to the SSSI are considered highly unlikely.

Ham Common LNR

The LNR is 1.35 km east of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Ham Lands LNR

The LNR is located adjacent to the estuarine Thames Tideway, however, the physical environment and water quality assessments identified negligible changes in water level, intertidal exposure and water quality throughout the reach. Therefore, negative impacts to the Ham Lands LNR arising from Beckton water recycling are considered highly unlikely.

Isleworth Ait LNR

The LNR is located within the estuarine Thames Tideway, however, the physical environment and water quality assessments identified negligible changes in water level, intertidal exposure and water quality throughout the reach. Therefore, negative impacts to the Isleworth Ait LNR arising from Beckton water recycling are considered highly unlikely.

Syon Park SSSI

The LNR is located adjacent to the estuarine Thames Tideway, however, the physical environment and water quality assessments identified negligible changes in water level, intertidal exposure and water quality throughout the reach. Therefore, negative impacts to the Syon Park SSSI arising from Beckton water recycling are considered highly unlikely.

Blondin Park, Northfields LNR

The LNR is 1.77 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Gunnersbury Triangle LNR

The LNR is 0.98 km east of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Barn Elms Wetland Centre SSSI

The Barn Elms Wetland Centre SSSI is fed by water pumped from the Thames-Lee tunnel, with the water entering the site through the Reservoir lagoon and returning to the estuarine River Thames via a tidal flap at low tide. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Barn Elms Wetland Centre SSSI are anticipated.

Barnes Common LNR

The LNR is 0.65 km west of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Duke's Hollow LNR

The LNR is located adjacent to the estuarine Thames Tideway, however, the physical environment and water quality assessments identified negligible changes in water level, intertidal exposure and water quality throughout the reach. Therefore, negative impacts to the Duke's Hollow LNR arising from the Beckton water recycling scheme are considered highly unlikely.

Chiswick Eyot LNR

The LNR is located within the estuarine Thames Tideway, however, the physical environment and water quality assessments identified negligible changes in water level, intertidal exposure and water quality throughout the reach. Therefore, negative impacts to the Chiswick Eyot LNR arising from the Beckton water recycling scheme are considered highly unlikely.

Leg of Mutton Reservoir LNR

The reservoir is adjacent to the estuarine Thames Tideway; however, it is level controlled via sluice gates. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Leg of Mutton Reservoir LNR are anticipated.

Battersea Park Nature Areas LNR

The LNR is located only 0.07 km south of the estuarine Thames Tideway, however, there is no known hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Battersea Park Nature Areas LNR are anticipated.

Lavender Pond LNR

The pond is connected to the estuarine Thames Tideway by Lavender Dock, however, it is level controlled. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Lavender Pond LNR are anticipated.

Russia Dock Woodland LNR

The ponds and wetlands are not connected to the estuarine Thames Tideway and are likely to be surface water fed. The site is separated from the tideway by the level-controlled Greenland Dock. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Russia Dock Woodland LNR are anticipated.

Mudchute Park Farm LNR

The LNR is located 0.26 km east of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Mudchute Park Farm LNR are anticipated.

Tower Hamlets Cemetery Park LNR

The LNR is located 1.4 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Tower Hamlets Cemetery Park LNR are anticipated.

Ackroyd Drive Greenlink LNR

The LNR is located 1.4 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Ackroyd Drive Greenlink LNR are anticipated.

Sue Godfrey Nature Park LNR

The LNR is located 0.5 km south of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Sue Godfrey Nature Park LNR are anticipated.

Gilbert's Pit (Charlton) SSSI and Maryon Wilson Park & Gilbert's Pit LNR

The SSSI is of interest for geological formations and will not be affected by hydrological changes in the estuarine Thames Tideway due to the distance to the site and absence of connectivity. The LNR is located 0.5 km south of the River Thames with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to these sites are anticipated.

Crossness LNR

The site borders the estuarine Thames Tideway but is located 1.0 km east and downstream of the estuarine Thames Tideway reach. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Crossness LNR are anticipated.

Ripple LNR

The LNR is located 0.6 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Ripple LNR are anticipated.

Stave Hill Ecology Park LNR

The ponds within the LNR are not connected to the estuarine Thames Tideway and are likely to be surface water fed. The site is separated from the river by the level-controlled Greenland Dock. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Stave Hill Ecology Park LNR are anticipated.

Brookmill Road LNR

The LNR is located 1.65km south of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Brookmill Road LNR are anticipated.

Scrattons Ecopark and Extension LNR

The LNR is 1.26km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Beckton water recycling scheme, no impacts to the Scrattons Ecopark and Extension LNR are anticipated.

A summary of potential impacts to the designated sites within 2km of the estuarine Thames Tideway is shown in Table 3-5.

Table 3-5 Beckton water recycling designated site impact assessment summary for the estuarine Thames Tideway

Site Name	Potential impacts	Further assessment required
Bushy Park and Home Park SSSI	No potential impacts identified	No
Richmond Park SSSI, NNR, and LNR	No potential impacts identified	No
Ham Common LNR	No potential impacts identified	No
Ham Lands LNR	No potential impacts identified	No
Isleworth Ait LNR	No potential impacts identified	No
Syon Park SSSI	No potential impacts identified	No
Blondin Park, Northfields LNR	No potential impacts identified	No
Gunnersbury Triangle LNR	No potential impacts identified	No
Barn Elms Wetland Centre SSSI	No potential impacts identified	No
Barnes Common LNR	No potential impacts identified	No
Duke's Hollow LNR	No potential impacts identified	No
Chiswick Eyot LNR	No potential impacts identified	No
Leg of Mutton Reservoir LNR	No potential impacts identified	No
Battersea Park Nature Areas LNR	No potential impacts identified	No
Lavender Pond LNR	No potential impacts identified	No
Russia Dock Woodland LNR	No potential impacts identified	No
Mudchute Park Farm LNR	No potential impacts identified	No
Tower Hamlets Cemetery Park LNR	No potential impacts identified	No
Ackroyd Drive Greenlink LNR	No potential impacts identified	No
Sue Godfrey Nature Park LNR	No potential impacts identified	No
Gilbert's Pit (Charlton) SSSI	No potential impacts identified	No
Maryon Wilson Park & Gilbert's Pit LNR	No potential impacts identified	No
Crossness LNR	No potential impacts identified	No
Ripple LNR	No potential impacts identified	No
Stave Hill Ecology Park LNR	No potential impacts identified	No
Brookmill Road LNR	No potential impacts identified	No
Scrattons Ecopark and Extension LNR	No potential impacts identified	No

3.9 SUMMARY OF AQUATIC ECOLOGY ASSESSMENT OF THE BECKTON WATER RECYCLING SCHEME

Table 3-6 summarises the potential aquatic ecology impacts for each of the sizes of a Beckton water recycling scheme.

Table 3-6 Summary of potential aquatic ecology impacts for the Beckton water recycling scheme

Size	Aquatic invertebrates freshwater	Aquatic invertebrates estuarine	Marginal habitat assessment	Plants/diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species
100 MI/d	Negligible aquatic invertebrates freshwater inferred from larger schemes	Negligible aquatic invertebrates estuarine inferred from larger schemes	Negligible marginal habitats inferred from larger schemes	Negligible plants/diatoms inferred from larger schemes	Negligible macroalgae, angiosperm and phytoplankton inferred from larger schemes	Negligible designated and protected sites and species inferred from larger schemes
200 MI/d						
300 MI/d	<p>Velocity and flow: Increased flows at discharge outfall may exceed tolerable range of some invertebrate species, favouring species with a greater tolerance.</p> <p>Increased wetted width during low flow could increase habitat availability in the channel, providing opportunity for larger invertebrate populations. Impact likely minor as increased wetted width is within artificial channel.</p> <p>No change in velocity or flow downstream of Flanders Weir.</p> <p>Temperature: Temperature increase not likely to exceed tolerable range. Negligible impact.</p> <p>Oxygen saturation: No impact.</p>	<p>Velocity and flow: No impacts expected.</p> <p>Temperature: No impacts expected.</p> <p>Dissolved oxygen: No data available.</p> <p>Dissolved inorganic nitrogen: No impacts expected.</p>	<p>Freshwater Lee Diversion Channel</p> <p>Minor positive change for TR_09 with increased hydraulic feature richness. Minor negative change for TR_09 with increased siltation and NNIPS extent.</p> <p>Overall decrease in preliminary condition score but remains in 'Fairly poor' category.</p>	<p>Macrophytes:</p> <p>Freshwater Lee Diversion Channel:</p> <p>Velocity and flow: Increased velocities and flows in ~100m reach of Enfield Island Loop have potential to change overall macrophyte community structure and favour taxa with preference for faster flowing water.</p> <p>Temperature: Temperature change could favour macrophytes with greater temperature tolerance. Temperature increase likely minor so no significant impacts expected.</p> <p>Oxygen saturation: Potential for minor positive impact due to minor increase in oxygen saturation.</p> <p>Phosphorous: Potential for minor positive impact due to minor decrease in phosphorous.</p> <p>Diatoms:</p> <p>Freshwater Lee Diversion Channel:</p> <p>Velocity and flow: Major increase in very low flows in ~100m reach of Enfield Island Loop. Potential to increase fitness and available habitat for high motility</p>	<p>Negligible macroalgae, angiosperm and phytoplankton impact.</p> <p>Further macroalgae surveys planned for September 2022 within the Upper and Middle Thames Tideway but not included within this report.</p>	<p>Freshwater Lee Diversion Channel: No potential impacts identified.</p> <p>Estuarine Thames Tideway: No potential impacts identified.</p>

Size	Aquatic invertebrates freshwater	Aquatic invertebrates estuarine	Marginal habitat assessment	Plants/diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species
	<p>Phosphorous: Negligible changes to phosphorous not likely to exceed tolerable range.</p>			<p>species. Potential for adverse impact to species with low motility. Temperature: Temperature increase will favour diatoms with greater tolerance range. Oxygen saturation: No impacts expected. Phosphorous: No impacts expected. Estuarine Thames Tideway: No impacts upon macrophytes and diatoms as: Velocity and flow: No impacts expected. Temperature: No impacts expected. Dissolved oxygen: No data available. Dissolved inorganic nitrogen: No impacts expected.</p>		

4. AQUATIC ECOLOGY ASSESSMENT OF MOGDEN WATER RECYCLING SCHEME

4.1 INTRODUCTION

This section sets out the assessment for the tasks set out in Table 1-1 relevant to the Mogden water recycling scheme. The study area for each task has been set out per task as it is not consistent across tasks. The Mogden water recycling scheme assessment for each of the following tasks has been set out in the following sections:

- Aquatic Invertebrates freshwater– Section 4.2
- Aquatic Invertebrates estuarine – Section 4.3
- Marginal habitat assessment – Section 4.4
- Macrophytes – Section 4.5
- Diatoms – Section 4.6
- Macroalgae, Angiosperm and Phytoplankton – Section 4.7
- Designated and protected sites and species – Section 4.8

The data used for undertaking the assessments has been outlined in Table 1-1.

These assessments have been undertaken for the following for each task:

- Aquatic invertebrates across Reaches A, B and C in the freshwater River Thames and Reaches D, E and F in the estuarine Thames Tideway
- Marginal habitats across Reaches A, B and C in the freshwater River Thames
- Macrophytes across Reaches A, B and C in the freshwater River Thames
- Diatoms across Reaches A, B and C in the freshwater River Thames and Reach E in the estuarine Thames Tideway
- Macroalgae, Angiosperm and Phytoplankton across Reaches D, E and F in the estuarine Thames Tideway
- Designated and protected sites and species across Reaches A, B and C in the freshwater River Thames and Reaches D, E and F in the estuarine Thames Tideway

Where text makes reference to A82 and M96 flow series, respectively these refer to 1 in 5 year and 1 in 20-year flow events.

These assessments have been conducted utilising impact assessments determined within the Physical Environment⁵³ and Water Quality⁵⁴ Gate 2 reports.

Summary of physical environment impacts associated with a Mogden water recycling scheme

The full assessment of the Gate 2 physical environment impacts of the Mogden water recycling schemes includes an assessment of:

- Velocity and flow,
- Outfall design,
- Wetted habitat,
- Fish pass and barrier passability,
- Richmond Pound drawdown, and
- Estuarine sediment.

Table 4-1 shows a high-level summary of these impacts, which are also briefly described below.

⁵³ Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Physical Environment Assessment Report.

⁵⁴ Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Water Quality Assessment Report.

Velocity and flow

The Mogden water recycling scheme is expected to result in moderate impacts (200 MI/d and 150 MI/d scheme sizes) to minor impacts (100 MI/d and 50 MI/d scheme sizes) to flow conditions within the Thames, the main flow increase is likely to occur between Walton Bridge outfall and Thames Water Walton intake. The area of increased velocity is spatially restricted to the outfall area and in the thalweg.

Outfall design

The potential impacts predicted for outfall design are negligible for all scheme sizes. At the 200 MI/d scheme size, increased velocities from plume of (0.05-0.075m/s) stretches downstream to around 260m for discharge into 950 MI/d (Q91) scenario.

Wetted habitat

The potential impacts predicted for wetted habitat are negligible for all scheme sizes, with very minor increases in flow velocities in Sunbury Weir pool modelled, no changes in wetted habitats modelled in Molesey Weir pool and negligible changes in exposure of estuarine wetted habitat.

Fish pass and barrier passability

The potential impacts predicted for fish pass and barrier passability are negligible for all scheme sizes, with a maximum change of between 0-0.04m in river levels for scheme when compared to baseline under the 200 MI/d scheme size.

Richmond Pound drawdown

The potential impacts predicted for Richmond Pound drawdown are negligible for all scheme sizes, with negligible changes to the physical environment.

Estuarine sediment

The potential impacts predicted for estuarine sediment are negligible for all scheme sizes, with negligible changes in suspended solids concentration within the estuary.

Table 4-1 Summary of potential physical environment impacts for Mogden water recycling schemes

Size	Flow	Outfall design	Wetted habitat	Richmond Pound drawdown	Estuarine sediment
50 MI/d	Minor 5% increase in very low flows (Q95) with main flow increase affecting 3.4km reach (Walton Bridge outfall to Walton intake) and no change 5.4km downstream of outfall (Hampton intake)	Negligible Plume velocity characteristics inferred from larger schemes modelling.	Very minor increase in flow velocities in Sunbury Weir pool inferred from larger schemes modelling. No change in wetted habitats modelled in Molesey Weir pool as no expected change in flows over Molesey Weir. Negligible changes in exposure of estuarine wetted habitat inferred from larger schemes modelling.	Negligible changes in physical environment within Richmond Pound.	Negligible changes in suspended solids concentration within the estuary.
100 MI/d	Minor 11% increase in very low flows (Q95) with main flow increase affecting 3.4km reach (Walton Bridge outfall to Walton intake) and no change 5.4km downstream of outfall (Hampton intake)				
150 MI/d	Moderate 16% increase in very low flows (Q95) with main flow increase affecting 3.4km reach (Walton Bridge outfall to Walton intake) and no change 5.4km downstream of outfall (Hampton intake)				
200 MI/d	Moderate 21% increase in very low flows (Q95) with main flow increase affecting 3.4km reach (Walton Bridge outfall to Walton intake) and no change 5.4km downstream of outfall (Hampton intake)				

Summary of water quality impacts associated with a Mogden water recycling scheme

The full assessment of the Gate 2 water quality impacts of the Mogden water recycling schemes includes an assessment of:

- Water temperature,
- General physico-chemical,
- WFD chemicals,
- Environmental Quality Standards Directive (EQSD) chemicals,
- Olfactory water quality, and
- Richmond Pound drawdown.

Table 4-2 shows a high-level summary of these impacts, which are also briefly described below.

Water temperature

Within the freshwater River Thames it is predicted that a maximum temperature change of 1.1°C may occur, achieving a maximum modelled temperature of 19.8 °C, therefore with respect to WFD, it is anticipated that at least 'Good' WFD status (23°C, 98%ile) will always be achieved with peak river temperatures estimated at 19.8°C - 19.9°C for when the Mogden water recycling scheme is operational) and that 'High' WFD status for salmonid category rivers (20°C, 98%ile) is likely.

In the upper Thames Tideway modelling predicts less warming in areas associated with the Mogden STW outfall, due to less final effluent discharge into the watercourse at these locations, with temperature reductions predicted of a maximum of 1 °C.

General physico-chemical

Within the freshwater River Thames, it is predicted that there may be minor changes in ammoniacal nitrogen within the 200 Ml/d scheme size, comprising decreases in concentration around the Reuse outfall at Walton Bridge and small increases in concentration downstream ranging from 15.54% change at the 25%ile to 0.33% change at the 90%ile at Teddington weir. Suspended solids show a minor reduction around the outfall, before increasing downstream with the most elevated increases being observed at the 25%ile.

For both dissolved oxygen saturation and phosphorus concentrations negligible changes are predicted with small (max change -0.01% at the 50%ile) and moderate (max change -7.45% at the 75%ile) reductions around the outfall respectively. Phosphorus concentrations continue to reduce downstream while dissolved oxygen saturation increases with distance from the outfall.

Within the upper Thames Tideway dissolved oxygen concentration increases, though this represents a maximum difference from reference conditions of 0.5 mg/l. Salinity also increases with a maximum increase of 1.3ppt, while DIN decreases with a maximum reduction of 25 µMol/l.

WFD chemicals

Within the upper Thames Tideway minor impacts are also predicted with eight additional chemicals (Benzyl butyl phthalate, Total chlorine, Chlorothalonil, Cybutryne (Irgarol), Cypermethrin, Hexachlorocyclohexane, Perfluorooctane sulfonic acid and its derivatives, Terbutryn) at risk of exceeding the standard under the 200 Ml/d scheme size.

EQSD chemicals

Within the upper Thames Tideway negligible impacts are also predicted with three additional chemicals (Bromine - total residual oxidant, Diflubenzuron, Pirimicarb) at risk of exceeding the standard under the 200 Ml/d scheme size.

Olfactory water quality

Within both the freshwater River Thames and upper Thames Tideway negligible impacts are predicted with no additional exceedances occurring from the reference conditions.

Richmond Pound drawdown

Negligible changes occur in the Richmond Pound with maximum increases in salinity of 0.55ppt and maximum (initial) temperature increases of 0.1°C. Temperature also displays maximum decreases of 1°C, suspended sediment decreases by a maximum of 0.045 and 0.015 kg/m³ under A82 and M96 respectively, and dissolved oxygen increases by a maximum of 0.5 mg/l.

Table 4-2 Summary of potential water quality impacts for Mogden water recycling schemes

Size	Water temperature	General physico-chemical	WFD chemicals	EQSD chemicals	Olfactory water quality	Richmond Pound Drawdown
50 MI/d	Freshwater: Negligible	Negligible general physio-chemical characteristics inferred from larger schemes modelling.	Negligible WFD chemicals inferred from larger schemes modelling.	Negligible EQSD chemicals inferred from larger schemes modelling.	Negligible Olfactory water quality inferred from larger schemes modelling.	Salinity: Negligible changes, with a maximum increase of 0.55 ppt under both A82 and M96. Suspended sediment: Negligible changes, with a maximum decrease of 0.045 and 0.015 kg/m ³ under A82 and M96 respectively. Dissolved oxygen: Negligible changes, with a maximum increase of 0.5 mg/l under both A82 and M96. Temperature: Negligible changes, with a maximum increase of 0.1°C under both A82 and M96, and maximum decreases of 1°C under both A82 and M96.
100 MI/d	Freshwater: Negligible					
150 MI/d	Freshwater: Negligible					
200 MI/d	Freshwater: Negligible Estuarine: Difference of around 1°C	<p>Freshwater Thames: <i>Ammoniacal nitrogen:</i> A82; minor changes with both increases and decreases on pressure. M96; added pressure at 90%ile. M96 future; minor added pressure. <i>Oxygen saturation:</i> A82; reduced pressure at Mogden water recycling outfall. M96; minor changes with reduction at Mogden water recycling outfall. M96 future; increase in pressure. <i>Suspended Solids:</i> A82; Minor increase in pressure from suspended solids at 25%ile, minor decrease at 75%ile. M96; increase in pressure across all percentiles. M96 future; decrease in pressure across all percentiles. <i>Phosphorous:</i> Decrease in pressure across all scenarios and percentiles. <i>Water temperature:</i> Minor increase in pressure across all scenarios and percentiles. <i>Hardness:</i> Increase in 48mg/l <i>ANC:</i> No change affected by scheme in operation. <i>pH:</i> No change affected by scheme in operation. <i>Langelier Saturation Index:</i> LSI of 0 is achievable.</p> <p>Estuarine Thames: DO: An increase in DO under both scenarios Salinity: Increase in salinity under both scenarios DIN: Decrease in pressure with a decrease in DIN under both scenarios.</p>	<p>Estuarine Thames: 12 determinands were exceeding standards under baseline conditions of which seven remained above standard under A82 and eight new pressures were above standard. The same occurs in the M96 scenario with one additional pressure.</p>	<p>Estuarine Thames: A82 and M96 estuary and freshwater; three new chemical exceedances.</p>	<p>Freshwater Thames: A82 and M96 have four exceedances which is the same number present at baseline.</p> <p>Estuarine Thames: A82 and M96 have five exceedances which is the same number present at baseline.</p>	

4.2 AQUATIC INVERTEBRATES FRESHWATER

4.2.1 Overview

This section sets out the assessment for the freshwater aquatic invertebrates in reaches potentially affected by the Mogden water recycling scheme.

- Freshwater River Thames - Section 4.2.2

4.2.2 Freshwater River Thames

Reach A – Shepperton Weir to Affinity Water Walton Intake

Table 4-1 summarises the potential physical environment impacts for each Mogden water recycling scheme volume scenarios.

Table 4-2 summarises the potential water quality impacts for each Mogden water recycling scheme volume scenarios.

Velocity and flow impacts upon the invertebrate community

No impacts are predicted for Reach A due to the location of the discharge downstream.

Temperature impacts upon the invertebrate community

No impacts are predicted for Reach A due to the location of the discharge downstream.

Oxygen Saturation impacts upon the invertebrate community

No impacts are predicted for Reach A due to the location of the discharge downstream.

Phosphorus impacts upon the invertebrate community

No impacts are predicted for Reach A due to the location of the discharge downstream.

pH impacts upon the invertebrate community

No impacts are predicted for Reach A due to the location of the discharge downstream.

Reach B – Affinity Water Walton Intake to Thames Water Walton Intake

Velocity and flow impacts upon the invertebrate community

Overall increased flows have the potential to increase the fitness and available habitat for species with a preference or tolerance to faster flows. However, velocity increases appear to be limited to the surface of the watercourse therefore the impact to the benthic invertebrate community may be limited.

Temperature impacts upon the invertebrate community

The impacts summarised above on the freshwater River Thames are not likely to exceed the tolerable range of any of the species found within the reach. Minor increases changes to temperature are expected under every scenario.

We may be able to provide more detail here once we have a better understanding of the impacts to native freshwater ecology.

Oxygen Saturation impacts upon the invertebrate community

Minor increases in dissolved oxygen under M96 future may result in a general improvement in biological fitness overall within the community, however this is not likely to result in impacts to the invertebrate community within the freshwater River Thames.

Phosphorus impacts upon the invertebrate community

The slight decrease in phosphorous predicted downstream of the outfall under A82 conditions are not likely to result in any measurables impact upon invertebrate preference.

pH impacts upon the invertebrate community

The minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the invertebrate community. Therefore, there is predicted to be no impact on invertebrates within the freshwater River Thames due to the scheme.

Reach C – Thames Water Walton Intake to Teddington Weir

Velocity and flow impacts upon the invertebrate community

Overall increased flows have the potential to increase the fitness and available habitat for species with a preference or tolerance to faster flows. However, velocity increases appear to be limited to the surface of the watercourse therefore the impact to the benthic invertebrate community is likely to be limited.

Temperature impacts upon the invertebrate community

The impacts summarised above on the freshwater River Thames are not likely to exceed the tolerable range of any of the species found within the reach. Minor increases changes to temperature are expected under every scenario.

We may be able to provide more detail here once we have a better understanding of the impacts to native freshwater ecology.

Oxygen Saturation impacts upon the invertebrate community

Minor increases in dissolved oxygen under M96 future may result in a general improvement in biological fitness overall within the community, however this is not likely to result in impacts to the invertebrate community within the freshwater River Thames.

Phosphorus impacts upon the invertebrate community

The slight decrease in phosphorous predicted downstream of the outfall under A82 conditions are not likely to result in any measurable impact upon invertebrate preference.

pH impacts upon the invertebrate community

The minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the invertebrate community. Therefore, there is predicted to be no impact on invertebrates within the freshwater River Thames due to the scheme.

4.3 AQUATIC INVERTEBRATES ESTUARINE

4.3.1 Overview

This section sets out the assessment for the estuarine aquatic invertebrates in reaches potentially affected by the Mogden water recycling scheme.

- Estuarine Thames Tideway - Section 4.3.2

4.3.2 Estuarine Thames Tideway

Reach D – Teddington Weir to Battersea Park

Table 4-1 summarises the potential physical environment impacts for each Mogden water recycling scheme volume scenarios.

Table 4-2 summarises the potential water quality impacts for each Mogden water recycling scheme volume scenarios.

Velocity and flow impacts upon the invertebrate community

No impacts on flow or velocity are expected within this reach.

Temperature impacts upon the invertebrate community

There is a possibility that maximum temperature increases of up to 1.1 °C such as those predicted above may potentially improve the fitness of individual invertebrate species currently present. Temperature increases are likely to increase the metabolic rates for all of the species present which may increase growth rates, fecundity or spawning periods, particularly for species close to their climatic range. However, as previously discussed, the realised impact on individual invertebrate preference resulting from relatively small changes to the physical environment cannot be predicted accurately as they are reliant upon numerous biotic and abiotic factors. The water temperature, however, is typically predicted to decrease, particularly around the outfall, which is not expected to have an impact on the invertebrate community.

Dissolved oxygen impacts upon the invertebrate community

It is predicted that dissolved oxygen in the upper Thames tideway will increase with negligible impacts, this is not likely to affect the invertebrate community due to the maximum increase of 0.5 mg/l.

Dissolved inorganic nitrogen impacts upon the invertebrate

Significant decreases in DIN are predicted for the Thames Tideway, this is not expected to negatively impact the invertebrate community the invertebrate community as the community has been determined to be tolerant to a wide range of nutrient conditions.

Reach E – Battersea Park to Tower Bridge

There are no data available to make an assessment on aquatic invertebrates in Reach E.

Reach F Tower Bridge to 3km seawards of Beckton STW

There are no data available to make an assessment on aquatic invertebrates in Reach F.

4.4 MARGINAL HABITAT ASSESSMENT

4.4.1 Overview

This section sets out the assessment for the marginal habitats in reaches potentially affected by the Mogden water recycling scheme.

- Freshwater River Thames - Section 4.4.2

The assessment on impacts to the RCA are based on outputs from the physical environment assessment report⁵⁵, INNS Report⁵⁶, and the macrophyte assessment (Section 4.5). The assessment assumes Scenario 1 (600 MI/d at 200 MI/d discharge) from Physical Environment Report.

In summary, there is a predicted moderate increase in very low flows, main flow increase affecting 3.4 km reach (Walton Bridge outfall to Thames Water Walton intake) and no change 5.4 km downstream of outfall (Thames Water Hampton intake). There is negligible change in wetted habitats. A full summary of predicted physical environment impacts is detailed in Section 4.1, Table 4-1. It is not likely that the introduction or transfer of INNS will occur during the operation of this scheme, as the water would be advanced treated effluent, which eliminates all pathways that are likely to introduce or transfer INNS during normal operation.

4.4.2 Freshwater River Thames

Reach A – Shepperton Weir to Affinity Water Walton Intake

TR_01 is located approximately 1.2km upstream of the Mogden water recycling discharge point on the freshwater River Thames. Therefore, there are no assessed changes to the RCA. This RCA can be used as a reference condition point.

Reach B – Affinity Water Walton Intake to Thames Water Walton Intake

The assessed changes in river condition indicators for RCAs within Reach B are presented in Table 4-3.

Although there will be the addition of artificial bank face structures (outfall) within the section of the river covered by TR_02, river condition indicators C7-C9 were assessed to be no change as the bank face in these locations are already modified channels.

River condition indicator E3, channel bed hydraulic features, was assessed to increase in the section of the river covered by TR_02 in this reach due to the discharge which has been shown to alter flow patterns, introducing more diversity of flow immediately downstream. This change in flow velocity rapidly declines by ~150m downstream of the discharge, with remaining flow velocities similar to upstream. Therefore, the predicted change in river condition indicator E3 is not applied to TR_03 and TR_04 which are located approximately 1.8km and 2.3km downstream of the outfall respectively.

Due to negligible predicted changes in wetted width, there are no assessed changes to the channel margin natural indicators, i.e., river condition indicator D1-D4.

There is no assessed change to indicators for TR_03 and TR_04 based on the operation of this scheme. The assessed changes to the indicator scores for TR_02 were positive (increased hydraulic feature richness). Overall, the preliminary condition score was increased to -0.096. This score meets the threshold for the Fairly Poor condition category of this river type, and the river condition is assessed to increase.

⁵⁵ Ricardo Energy & Environment. (2022). *London Effluent Reuse SRO. Aquatic Physical Environment Assessment Report Draft 2.0*. Ref. 4700399659. Ricardo ref. ED13591.

⁵⁶ Ricardo Energy & Environment. (2022). *London Effluent Reuse SRO. INNS Assessment Report Draft 1.0*. Ref. 4700399659. Ricardo ref. ED13591.

Table 4-3 Assessed changes in river condition indicators of Reach B during operation of 200 Ml/d Mogden water recycling scheme. Green shading indicates a positive change (i.e., a higher positive score or a lower negative score), and red shading indicates a negative change (i.e., a lower positive score or a higher negative score). '-' in the operational column indicates no change to the baseline score.

Code	Indicator name	Positive / Negative type	TR_02 baseline	TR_02 operational	TR_03 baseline	TR_03 operational	TR_04 baseline	TR_04 operational
B1	Bank top vegetation structure	Positive	3	-	3	-	3	-
B2	Bank top tree feature richness	Positive	0	-	2	-	1	-
B3	Bank top water related features	Positive	0	-	0	-	0	-
B4	Bank top NNIPS cover	Negative	0	-	0	-	0	-
B5	Bank top managed ground cover	Negative	-4	-	-3	-	-4	-
C1	Bank face riparian vegetation structure	Positive	2	-	3	-	2	-
C2	Bank face tree feature richness	Positive	1	-	4	-	1	-
C3	Bank face natural bank profile extent	Positive	0	-	3	-	1	-
C4	Bank face natural bank profile richness	Positive	0	-	4	-	1	-
C5	Bank face natural bank material richness	Positive	1	-	4	-	0	-
C6	Bank face bare sediment extent	Positive	1	-	3	-	0	-
C7	Bank face artificial bank profile extent	Negative	-4	-	0	-	-4	-
C8	Bank face reinforcement extent	Negative	-4	-	0	-	-4	-
C9	Bank face reinforcement material severity	Negative	-4	-	0	-	-4	-
C10	Bank face NNIPS cover	Negative	0	-	0	-	0	-
D1	Channel margin aquatic vegetation extent	Positive	1	-	2	-	2	-
D2	Channel margin aquatic morphotype richness	Positive	1	-	1	-	1	-
D3	Channel margin physical feature extent	Positive	0	-	2	-	0	-
D4	Channel margin physical feature richness	Positive	0	-	2	-	0	-
D5	Channel margin artificial features	Negative	-2	-	0	-	0	-
E1	Channel bed aquatic morphotype richness	Positive	0	-	0	-	0	-
E2	Channel bed tree features richness	Positive	0	-	2	-	1	-

Code	Indicator name	Positive / Negative type	TR_02 baseline	TR_02 operational	TR_03 baseline	TR_03 operational	TR_04 baseline	TR_04 operational
E3	Channel bed hydraulic features richness	Positive	0	1	2	-	4	-
E4	Channel bed natural features extent	Positive	0	-	2	-	0	-
E5	Channel bed natural features richness	Positive	0	-	1	-	0	-
E6	Channel bed material richness	Positive	0	-	3	-	0	-
E7	Channel bed siltation	Negative	0	-	0	-	0	-
E8	Channel bed reinforcement extent	Negative	0	-	0	-	0	-
E9	Channel bed reinforcement severity	Negative	0	-	0	-	0	-
E10	Channel bed artificial features severity	Negative	-2	-	0	-	-3	-
E11	Channel bed NNIPS extent	Negative	0	-	0	-	0	-
E12	Channel bed filamentous algae extent	Negative	0	-	0	-	0	-
Preliminary condition score:			-1.012	-0.096	2.032	No change	-0.567	No change
River condition category:			Poor	Fairly Poor	Fairly Good	No change	Fairly Poor	No change

Reach C – Thames Water Walton Intake to Teddington Weir

In accordance with the physical environment report, there is no predicted changes in the flows 5.4km downstream of the outfall (Hampton intake). As TR_05, TR_06, TR_07 and TR_08 are all downstream of this location, and there are negligible predicted changes to all other indicators, there is no assessed changes to the RCAs (Table 4-5).

There is no assessed change to indicators for TR_05, TR_06, TR_07 and TR_08 based on the operation of this scheme.

4.5 MACROPHYTES

4.5.1 Overview

This section sets out the assessment for the macrophyte communities in reaches potentially affected by the Mogden water recycling scheme.

- Freshwater Thames – Section 4.5.2

4.5.2 Freshwater Thames Tideway

Reach A – Shepperton Weir to Affinity Water Walton Intake

Velocity and flow impacts upon the macrophyte community

No impacts are predicted in Reach A due to the location of the discharge downstream.

Temperature impacts upon the macrophyte community

No impacts are predicted in Reach A due to the location of the discharge downstream.

Oxygen Saturation impacts upon the macrophyte community

No impacts are predicted in Reach A due to the location of the discharge downstream.

Reach B – Affinity Water Walton Intake to Thames Water Walton Intake

Velocity and flow impacts upon the macrophyte community

Overall increased flows have the potential to increase the fitness and available habitat for species with a preference or tolerance to faster flows.

Temperature impacts upon the macrophyte community

The results of the water quality modelling indicate that changes are expected to be minimal with a slight increase in temperature. The temperature will likely remain within the range of tolerance for majority of the taxa present and will likely be within the inter annual variations that would be observed under reference conditions. Therefore, no significant impacts are anticipated on the macrophyte communities.

Oxygen Saturation impacts upon the macrophyte community

The increases in oxygen saturation predicted downstream of the outfall under A82 conditions are not likely to result in any measurable impact on the macrophyte communities present as negligible changes are predicted.

pH impacts upon the macrophyte community

The minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the macrophytes found within this reach. Therefore, there is predicted to be no impact on macrophyte communities within the freshwater River Thames due to the scheme.

Reach C – Thames Water Walton Intake to Teddington Weir

Velocity and flow impacts upon the macrophyte community

Overall increased flows have the potential to increase the fitness and available habitat for species with a preference or tolerance to faster flows.

Temperature impacts upon the macrophyte community

It is unlikely that temperature changes of up to 1.1 °C will impact macrophyte communities significantly. The temperature will likely remain within the range of tolerance for majority of the taxa present and will likely be

within the inter annual variations that would be observed under reference conditions. Therefore, no significant impacts are anticipated on the macrophyte communities.

Oxygen Saturation impacts upon the macrophyte community

The increases in oxygen saturation predicted downstream of the outfall under A82 conditions are not likely to result in any measurable impact on the macrophyte communities present as negligible changes are predicted.

pH impacts upon the macrophyte community

The minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the macrophytes. Therefore, there is predicted to be no impact on macrophyte communities within the freshwater River Thames due to the scheme.

4.6 DIATOMS

4.6.1 Overview

This section sets out the assessment for the plants/diatoms in reaches potentially affected by the Mogden water recycling scheme.

- Freshwater River Thames - Section 4.6.2
- Estuarine Thames Tideway – Section 4.6.3

4.6.2 Freshwater River Thames

Table 4-1 summarises the potential physical environment impacts for each Mogden water recycling scheme volume scenarios.

Table 4-2 summarises the potential water quality impacts for each Mogden water recycling scheme volume scenarios.

Reach A – Shepperton Weir to Affinity Water Walton Intake

Velocity and flow impacts upon the diatom community

No impacts are predicted for Reach A due to the location of the discharge downstream.

Temperature impacts upon the diatom community

No impacts are predicted for Reach A due to the location of the discharge downstream.

Oxygen Saturation impacts upon the diatom community

No impacts are predicted for Reach A due to the location of the discharge downstream.

Reach B – Affinity Water Walton Intake to Thames Water Walton Intake

Velocity and flow impacts upon the diatom community

Increased flows immediately adjacent to the discharge outfall may have the potential to increase the fitness and available habitat for species with high motility. With higher motility, diatoms will be able to find and seek refuge in new habitats along the reach.

Conversely, immediately upstream and downstream of the outfall, the simulation predicts that there will be areas with a flow reduction. Diatoms with high motility are able to move with flows, whereas those with low motility cannot. These sections, therefore, have the potential to have an adverse impact on those diatom communities with little motility. From the samples collected within this reach, LRUS-002 has a relatively high proportion of its diatom community that is motile. This suggests that there are communities within the reach that can withstand a reduction in flows. LRUS-003 however has a relatively low proportion of diatoms present with mobility. Therefore, these are likely to be affected by a reduction in flows in this area.

Temperature impacts upon the diatom community

There is a possibility that temperature increases of up to 0.98 °C such as those predicted above may potentially improve the fitness of individual diatom species. Conversely, an increase in temperature also may have negative impacts on diatom communities. It is possible that by increasing temperature, there will be a reduction in optimum conditions for diatom species. Increasing temperatures have also been found to slow or stop

division rates within diatom species when upper tolerances have been reached. Therefore, those diatom species with a higher temperature tolerance may outcompete other species.

Oxygen Saturation impacts upon the diatom community

The increases in oxygen saturation predicted downstream of the outfall under A82 conditions are not likely to result in any measurable impact on the diatom communities present as negligible changes are predicted. It has also been found that when subjected to lowering levels of oxygen, diatoms primary production has not been negatively impacted.

Phosphorus impacts upon the diatom community

Changing phosphorus concentrations has shown growth responses in relation to diatoms. Dependent on current phosphorus concentrations, the reduction in concentration downstream could increase growth within the current diatom communities by bringing concentrations below the threshold. However, it could also lead to areas whereby growth rates and cell-division rates decrease, as diatoms are unable to dominate when phosphate is deficient.

pH impacts upon the diatom community

The minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the diatom communities present. Therefore, there is predicted to be no impact on diatom communities within the freshwater River Thames due to the scheme.

Reach C – Thames Water Walton Intake to Teddington Weir

Velocity and flow impacts upon the diatom community

Increased flows immediately adjacent to the discharge outfall may have the potential to increase the fitness and available habitat for species with high motility. With higher motility, diatoms will be able to find and seek refuge in new habitats along the reach.

Diatoms with high motility are able to move with flows, whereas those with low motility cannot. These sections, therefore, have the potential to have an adverse impact on those diatom communities with little motility. From the samples collected within this reach, all sites recorded varied results regarding mean motility percentage. The highest mean score was recorded at LRUS-006, which suggests the community here will not be as affected by reducing flows as the other sites on the reach. Overall, the motility is relatively low, and therefore diatoms in this reach are likely to be affected in areas whereby there is a reduction in flows.

Temperature impacts upon the diatom community

There is a possibility that temperature increases of up to 1.1 °C such as those predicted above may potentially improve the fitness of individual diatom species. Conversely, an increase in temperature also may have negative impacts on diatom communities. It is possible that by increasing temperature, there will be a reduction in optimum conditions for diatom species. Increasing temperatures have also been found to slow or stop division rates within diatom species when upper tolerances have been reached. Therefore, those diatom species with a higher temperature tolerance may outcompete other species.

Oxygen Saturation impacts upon the diatom community

The increases in oxygen saturation predicted downstream of the outfall under A82 conditions are not likely to result in any measurable impact on the diatom communities present in Reach C as negligible changes are predicted. It has also been found that when subjected to lowering levels of oxygen, diatoms primary production has not been negatively impacted.

pH impacts upon the diatom community

The minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the diatoms. Therefore, there is predicted to be no impact on diatom communities within the freshwater River Thames due to the scheme.

4.6.3 Estuarine Thames Tideway

Table 4-1 summarises the potential physical environment impacts for each Mogden water recycling scheme volume scenarios.

Table 4-2 summarises the potential water quality impacts for each Mogden water recycling scheme volume scenarios.

Reach D – Teddington Weir to Battersea Park

There are no data available to make an assessment on diatoms within Reach D.

Reach E – Battersea Park to Tower Bridge

Velocity and flow impacts upon the diatom community

No impacts on flow or velocity are expected within this reach.

Temperature impacts upon the diatom community

No impacts on temperature are expected within this reach.

Dissolved oxygen impacts upon the diatom community

It is predicted that dissolved oxygen in the upper Thames tideway will increase with negligible impacts, this is not likely to affect the diatom community due to the maximum increase of 0.5 mg/l.

Dissolved inorganic nitrogen impacts upon the diatom community

Significant decreases in DIN are predicted for the estuarine Thames Tideway, this is not expected to impact the diatom community as the community has been determined to be tolerant to a moderate to low organic pollution. However, the reduction in DIN may increase the presence of more sensitive diatom species.

Reach F Tower Bridge to 3km seawards of Beckton STW

There are no data available to make an assessment on diatoms within Reach F.

4.7 MACROALGAE, ANGIOSPERM AND PHYTOPLANKTON

4.7.1 Overview

This section sets out the assessment for the macroalgae, angiosperm and phytoplankton in reaches potentially affected by the Mogden water recycling scheme. It should be noted that marine angiosperms are not present within the upper and middle Thames Tideway and that known beds are circa 85km down river of Mogden STW.

- Estuarine Thames Tideway – Section 4.7.2

4.7.2 Estuarine Thames Tideway

Table 4-1 summarises the potential physical environment impacts for each Mogden water recycling scheme volume scenarios.

Table 4-2 summarises the potential water quality impacts for each Mogden water recycling scheme volume scenarios.

Reach D – Teddington Weir to Battersea Park

Velocity and flow impacts upon the macroalgae and phytoplankton community

No impacts on flow or velocity are expected within this reach.

Temperature impacts upon the macroalgae and phytoplankton community

No impacts on temperature are expected within this reach.

Dissolved oxygen impacts upon the macroalgae and phytoplankton community

It is predicted that dissolved oxygen in the upper Thames tideway will increase with negligible impacts, this is not likely to affect the macroalgal community or the phytoplankton community due to the maximum increase of 0.5 mg/l.

Dissolved inorganic nitrogen impacts upon the macroalgae and phytoplankton community

Significant decreases in DIN are predicted for the estuarine Thames Tideway, this is not expected to impact the macroalgal community as the community has been determined to be in an impacted state. However, the reduction in DIN may increase the presence of more sensitive macroalgal species. It is also considered that a

reduction in DIN will not negatively impact the phytoplankton community, which is in an unimpacted state, as DIN reductions are likely to increase the fitness of the community.

Reach E – Battersea Park to Tower Bridge

There are no data available to make an assessment on macroalgae within Reach E.

Reach F Tower Bridge to 3km seawards of Beckton STW

There are no data available to make an assessment on macroalgae within Reach F.

4.8 DESIGNATED AND PROTECTED SITES AND SPECIES

4.8.1 Overview

This section sets out the assessment for the designated and protected sites and species in reaches potentially affected by the Mogden water recycling scheme.

- Freshwater River Thames - Section 4.8.2
- Estuarine Thames Tideway – Section 4.8.3

4.8.2 Freshwater River Thames

Table 4-1 summarises the potential physical environment impacts for each Mogden water recycling scheme volume scenarios.

Table 4-2 summarises the potential water quality impacts for each Mogden water recycling scheme volume scenarios.

Dumsey Meadow SSSI

The site borders the freshwater River Thames but is located 1.88 km west and 3.3 km upstream of the freshwater River Thames reach. Therefore, there is no potential for impacts to the qualifying features of Dumsey Meadow SSSI due to hydrological or water quality changes associated with the Mogden water recycling scheme.

Chertsey Meads LNR

The site borders the freshwater River Thames but is located 1.02 km west and 2.15 km upstream of the freshwater River Thames reach. Therefore, due to the lack of impact pathways there is no potential for impacts to the qualifying features of Chertsey Meads LNR due to hydrological or water quality changes associated with the Mogden water recycling scheme.

Ash Link LNR

The LNR is located 1.85km north of the freshwater River Thames reach. The site borders the River Ash which is upstream of the River Thames and therefore not hydrologically dependent on the freshwater River Thames reach for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are highly unlikely.

Knight & Bessborough Reservoirs SSSI

The reservoirs are located over 0.55 km from the River Thames and are not hydrologically dependent on the freshwater River Thames reach for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the SSSI are highly unlikely.

Kempton Park Reservoirs SSSI and LNR

The reservoirs are located over 1.22 km north of River Thames and are not hydrologically dependent on the freshwater River Thames reach for water level or water quality. Kempton Park Reservoir East is not operational and is managed as a nature reserve. Therefore, due to the distance and absence of impact pathways potential impacts to the SSSI are considered to be highly unlikely.

Molesey Heath LNR

The LNR is 1.46 km south of the River Thames adjacent to the River Mole. Due to the distance, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the freshwater

River Thames reach for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Bushy Park and Home Park SSSI

The SSSI is located only 0.03 km from the River Thames however the site is not designated for water dependent features and is not reliant on the level, flow, or water quality of the freshwater River Thames reach for maintenance of site condition. Therefore, due to the absence of impact pathways, potential impacts to the SSSI are considered to be highly unlikely.

Stokes field LNR

The LNR is 1.12 km south of the freshwater River Thames with no hydrological connectivity to the site. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Oak Hill Woods LNR

The LNR is located 1 km south of the freshwater River Thames with no hydrological connectivity (site is above the level of the river) to the site. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Richmond Park SSSI, NNR, and LNR

Richmond Park is located over 1.25 km from the freshwater River Thames reach and is not designated for water dependent features. Therefore, it is not reliant on the level, flow, or water quality of the freshwater River Thames for maintenance of site condition. Therefore, due to the absence of impact pathways, potential impacts to the SSSI are considered to be highly unlikely.

Ham Common LNR

The LNR is 0.85 km east of the freshwater River Thames with no hydrological connectivity to the site. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Oak Avenue Hampton LNR

The LNR is located 1.91km north of the freshwater River Thames and is not designated for water dependent features. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Ham Lands LNR

The potential impacts on this site are outlined in Section 4.8.3.

A summary of potential impacts to the designated sites within 2km of the freshwater River Thames is shown in Table 4-4.

Table 4-4 Mogden water recycling scheme designated site impact assessment summary for the freshwater River Thames

Site Name	Potential impacts	Further assessment required
Dumsey Meadows SSSI	No potential impacts identified	No
Chertsey Meadow LNR	No potential impacts identified	No
Ash Link LNR	No potential impacts identified	No
Knight & Bessborough Reservoirs SSSI	No potential impacts identified	No
Southwest London Waterbodies SPA	No potential impacts identified	No
Southwest London Waterbodies Ramsar	No potential impacts identified	No
Kempton Park Reservoirs SSSI	No potential impacts identified	No
Kempton park LNR	No potential impacts identified	No
Molesey Heath LNR	No potential impacts identified	No

Site Name	Potential impacts	Further assessment required
Bushy Park and Home Park SSSI	No potential impacts identified	No
Stokes field LNR	No potential impacts identified	No
Oak Hill Woods LNR	No potential impacts identified	No
Richmond Park SSSI, NNR, and LNR	No potential impacts identified	No
Ham Common LNR	No potential impacts identified	No
Oak Avenue Hampton LNR	No potential impacts identified	No

4.8.3 Estuarine Thames Tideway

Bushy Park and Home Park SSSI

The potential impacts on this site are as outlined in Section 4.8.2.

Richmond Park SSSI, NNR, and LNR

The potential impacts on this site are as outlined in Section 4.8.2.

Ham Common LNR

The potential impacts on this site are as outlined in Section 4.8.2.

Ham Lands LNR

A reduction in water level, as linked to a reduction in tidal level, could alter the inundation frequency or groundwater level in the flood meadow habitat. However, the modelling and physical environment assessment identified that there would be a negligible change in water level throughout the reach and negligible changes in intertidal exposure in the estuarine Thames Tideway. Minor alterations in tidal exposure could result in a minor increase in duration that marginal vegetation is exposed. However, negative impacts to the Ham Lands LNR in the estuarine Thames Tideway reach are considered to be highly unlikely due to the negligible hydrological change predicted.

Isleworth Ait LNR

A change in water level as linked to tidal level could alter the inundation frequency or water level in the marginal habitats of the LNR which support a variety of waterside plants and two nationally rare snails. The modelling and physical environment assessment identified that there would be a negligible change in water level throughout the reach and negligible changes in intertidal exposure. Minor alterations in tidal exposure could result in a minor increase in duration that marginal vegetation is exposed. However, negative impacts to the habitats at Isleworth Ait LNR in the estuarine Thames Tideway are considered to be highly unlikely due to the negligible hydrological change predicted.

Syon Park SSSI

A change in water level as linked to tidal level could alter the inundation frequency or water level in wet grassland, reed beds, and intertidal muds which support the notable species of interest at the Syon Park SSSI. The modelling and physical environment assessment identified that there would be a negligible change in water level throughout the reach and negligible changes in intertidal exposure. Minor alterations in tidal exposure could result in a minor increase in duration that marginal vegetation is exposed. However, negative impacts to the habitats that support the designated species at Syon Park SSSI in the estuarine Thames Tideway are considered to be highly unlikely due to the negligible hydrological change predicted.

Blondin Park, Northfields LNR

The LNR is 1.77 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Gunnersbury Triangle LNR

The LNR is 0.98 km east of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on Reach D for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Barn Elms Wetland Centre SSSI

The Barn Elms Wetland Centre SSSI is fed by water pumped from the Thames-Lee tunnel, with the water entering the site through the Reservoir lagoon and returning to the estuarine Thames Tideway via a tidal flap at low tide. The hydrological impact within the estuarine Thames Tideway is therefore not anticipated to result in an alteration in water level or quality within the site and has not been identified to impact on the Thames-Lee tunnel or require its closure. Therefore, due to the absence of impact pathways, no impacts to the Barn Elms Wetland Centre SSSI are anticipated.

Barnes Common LNR

The LNR is 0.65 km west of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Duke's Hollow LNR

A change in water level as linked to tidal level could alter the inundation frequency or water level in the natural tidal foreshore of the LNR which supports a variety of waterside plants and two nationally rare snails. The modelling and physical environment assessment identified that there would be a negligible change in water level throughout the reach and negligible changes in intertidal exposure. Minor alterations in tidal exposure could result in a minor increase in duration that marginal vegetation is exposed. However, negative impacts to the habitats that support the designated species at Duke's Hollow LNR in the estuarine Thames Tideway are considered to be highly unlikely due to negligible hydrological change predicted.

Chiswick Eyot LNR

A change in water level as linked to tidal level could alter the inundation frequency or water level in the marginal habitats of the LNR. The modelling and physical environment assessment identified that there would be a negligible change in water level throughout the reach and negligible changes in intertidal exposure. Minor alterations in tidal exposure could result in a minor increase in duration that marginal vegetation is exposed. However, negative impacts to the habitats that support the designated species at Chiswick Eyot LNR in the estuarine Thames Tideway are considered to be highly unlikely due to the negligible hydrological change predicted.

Leg of Mutton Reservoir LNR

The reservoir is adjacent to the estuarine Thames Tideway; however, it is level controlled via sluice gates and would therefore not be affected by changes in level or flow rate in the tidal reach of the estuarine Thames Tideway. Therefore, no potential impacts to the site are anticipated due to hydrological changes in the estuarine Thames Tideway.

Battersea Park Nature Areas LNR

The LNR is located only 0.07 km south of the estuarine Thames Tideway however there is no known hydrological connectivity to the site. The habitats present in the site are unlikely to be hydrologically dependent on the estuarine Thames Tideway water level or water quality for maintenance of the habitat condition. Therefore, due to the distance and absence of potential impact pathways, negative impacts to the LNR are considered highly unlikely.

Lavender Pond LNR

The pond is connected to the estuarine Thames Tideway by Lavender Dock however it is level controlled and would not be affected by changes in level or flow rate in the tidal reach of the estuarine Thames Tideway. Therefore, no potential impacts to the site are anticipated due to hydrological changes in the estuarine Thames Tideway.

Russia Dock Woodland LNR

The ponds and wetlands are not connected to the estuarine Thames Tideway and are likely to be surface water fed. The site is separated from the river by the level-controlled Greenland Dock and would not be affected by changes in level or flow rate in the estuarine Thames Tideway. Therefore, potential impacts resulting from the Mogden water recycling scheme are considered highly unlikely.

Mudchute Park Farm LNR

The LNR is located 0.26 km east of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Tower Hamlets Cemetery Park LNR

The LNR is located 1.4 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Ackroyd Drive Greenlink LNR

The LNR is located 1.4 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance and absence of both impact pathways and water dependent features, potential impacts to the LNR are considered to be highly unlikely.

Sue Godfrey Nature Park LNR

The LNR is located 0.5 km south of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance and absence of both impact pathways and water dependent features, potential impacts to the LNR are considered to be highly unlikely.

Gilbert's Pit (Charlton) SSSI and Maryon Wilson Park & Gilbert's Pit LNR

The SSSI is of interest for geological formations and will not be affected by negligible hydrological changes in the estuarine Thames Tideway due to the distance to the site and absence of connectivity. The LNR is located 0.5 km south of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance and absence of both impact pathways and water dependent features, potential impacts to the LNR are considered to be highly unlikely.

Crossness LNR

The site borders the estuarine Thames Tideway but is located 1.0 km east and downstream of the estuarine Thames Tideway reach. Therefore, due to the lack of impact pathways there is no potential for impacts to the qualifying features of Crossness LNR due to hydrological or water quality changes associated with the Mogden water recycling scheme.

Ripple LNR

The LNR is located 0.6 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Stave Hill Ecology Park LNR

The ponds within the LNR are not connected to the estuarine Thames Tideway and are likely to be surface water fed. The site is separated from the river by the level-controlled Greenland Dock and would not be affected by changes in level or flow rate in the estuarine Thames Tideway. Therefore, potential impacts resulting from the Mogden water recycling scheme are considered highly unlikely.

Brookmill Road LNR

The LNR is located 1.65km south of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to

be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Scrattons Ecopark and Extension LNR

The LNR is 1.26km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

A summary of potential impacts to the designated sites within 2km of the estuarine Thames Tideway is shown in Table 4-5.

Table 4-5 Mogden water recycling designated site impact assessment summary for the estuarine Thames Tideway

Site Name	Potential impacts	Further assessment required
Ham Lands LNR	Minor alterations in tidal exposure could result in minor increase in duration that marginal vegetation is exposed. However due to the negligible impacts to water level this is unlikely to be significant.	No
Isleworth Ait LNR	Minor alterations in tidal exposure could result in minor increase in duration that marginal vegetation is exposed. However due to the negligible impacts to water level this is unlikely to be significant.	No
Syon Park SSSI	Minor alterations in tidal exposure could result in minor increase in in intertidal habitat availability. However, this is unlikely to be significant.	No
Blondin Park, Northfields LNR	No potential impacts identified	No
Gunnersbury Triangle LNR	No potential impacts identified	No
Barn Elms Wetland Centre SSSI	No potential impacts identified	No
Barnes Common LNR	No potential impacts identified	No
Duke's Hollow LNR	Minor alterations in tidal exposure could result in minor increase in duration that marginal vegetation is exposed. However due to the negligible impacts to water level this is unlikely to be significant.	No
Chiswick Eyot LNR	Minor alterations in tidal exposure could result in minor increase in duration that marginal vegetation is exposed. However due to the negligible impacts to water level this is unlikely to be significant.	No
Leg of Mutton Reservoir LNR	No potential impacts identified	No
Battersea Park Nature Areas LNR	No potential impacts identified	No
Lavender Pond LNR	No potential impacts identified	No
Russia Dock Woodland LNR	No potential impacts identified	No
Mudchute Park Farm LNR	No potential impacts identified	No
Tower Hamlets Cemetery Park LNR	No potential impacts identified	No
Ackroyd Drive Greenlink LNR	No potential impacts identified	No
Sue Godfrey Nature Park LNR	No potential impacts identified	No
Gilbert's Pit (Charlton) SSSI	No potential impacts identified	No
Maryon Wilson Park & Gilbert's Pit LNR	No potential impacts identified	No

Site Name	Potential impacts	Further assessment required
Crossness LNR	No potential impacts identified	No
Ripple LNR	No potential impacts identified	No
Stave Hill Ecology Park LNR	No potential impacts identified	No
Brookmill Road LNR	No potential impacts identified	No
Scrattons Ecopark and Extension LNR	No potential impacts identified	No

4.9 SUMMARY OF AQUATIC ECOLOGY ASESMENT OF THE MOGDEN WATER RECYCLING SCHEME

Table 4-6 summarises the potential aquatic ecology impacts for each of the sizes of a Mogden water recycling scheme.

Table 4-6 Summary of potential aquatic ecology impacts for Mogden water recycling scheme

Size	Aquatic invertebrates freshwater	Aquatic invertebrates estuarine	Marginal habitat assessment	Plants/diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species
50 MI/d	Negligible aquatic invertebrates freshwater inferred from larger schemes	Negligible aquatic invertebrates estuarine inferred from larger schemes	Negligible marginal habitats inferred from larger schemes	Negligible plants/diatoms inferred from larger schemes	Negligible macroalgae, angiosperm and phytoplankton inferred from larger schemes	Negligible designated and protected sites and species inferred from larger schemes
100 MI/d						
150 MI/d						
200 MI/d	<p>Velocity and flow: Increased flows at discharge outfall may exceed tolerable range of some invertebrate species, favouring species with a greater tolerance. Impact minor as most species are benthic and velocity increases limited to surface of watercourse. Reduced flow up and downstream of outfall may create a minor increase in capacity for species favouring slow flowing water.</p> <p>Temperature: Temperature increase not likely to exceed tolerable range. Possible increase in metabolic rates of species present.</p> <p>Dissolved oxygen: No impacts expected.</p> <p>Temperature: Temperature increase not likely to exceed tolerable range. Possible increase in metabolic rates of species present.</p> <p>Oxygen saturation: Slight increase in oxygen saturation with potential to improve biological</p>	<p>Velocity and flow: No impacts predicted.</p> <p>Temperature: Temperature increase not likely to exceed tolerable range. Possible increase in metabolic rates of species present.</p> <p>Dissolved oxygen: No impacts expected.</p> <p>Dissolved inorganic nitrogen: No impacts expected.</p>	<p>Freshwater River Thames: No changes to TR_01 upstream of Mogden water recycling outfall. Minor positive change to indicator score for TR_02 due to increased hydraulic feature richness. River condition assessed to increase in this location. No assessed change to indicators TR_03, TR_04, TR_05, TR_06, TR_07 or TR_08 downstream of outfall.</p>	<p>Freshwater River Thames:</p> <p>Velocity and flow: Increased flows at discharge outfall potential to increase fitness and habitat availability for diatom species with high motility. In areas up and downstream of the outfall with reduced flow there will likely be a minor adverse impact on diatom communities with low motility.</p> <p>Temperature: Temperature increase will favour diatoms with greater tolerance range.</p> <p>Oxygen saturation: Slight increase in oxygen saturation downstream of outfall, negligible impact.</p>	<p>Negligible macroalgae, angiosperm and phytoplankton impact.</p>	<p>Freshwater River Thames: No potential impacts identified.</p> <p>Estuarine Thames Tideway: Minor alterations in tidal exposure could result in minor increase in exposure of marginal vegetation.</p>

Size	Aquatic invertebrates freshwater	Aquatic invertebrates estuarine	Marginal habitat assessment	Plants/diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species
	<p>fitness. Negligible impact.</p> <p>Phosphorous: Decrease in phosphorous may have a minor positive impact on individual invertebrate preference.</p> <p>pH: pH change not likely to exceed tolerable range. No impact.</p>			<p>Estuarine Thames Tideway:</p> <p>Velocity and flow: No impacts expected.</p> <p>Temperature: No impacts expected.</p> <p>Dissolved oxygen: No impacts expected.</p> <p>Dissolved inorganic nitrogen: No impacts expected.</p>		

5. AQUATIC ECOLOGY ASSESSMENT OF TEDDINGTON DRA SCHEME

5.1 INTRODUCTION

This section sets out the assessment for the tasks set out in Table 1-1 relevant to the Teddington DRA scheme. The study area for each task has been set out per task as it is not consistent across tasks. The Teddington DRA scheme assessment for each of the following tasks has been set out in the following sections:

- Aquatic Invertebrates freshwater– Section 5.2
- Aquatic Invertebrates estuarine – Section 5.3
- Marginal habitat assessment – Section 5.4
- Macrophytes – Section 5.5
- Diatoms – Section 5.6
- Macroalgae, Angiosperm and Phytoplankton – Section 5.7
- Designated and protected sites and species – Section 5.8

The data used for undertaking the assessments has been outlined in Table 1-1.

These assessments have been undertaken for the following for each task:

- Aquatic invertebrates across Reaches A, B and C in the freshwater River Thames and Reaches D, E and F in the estuarine Thames Tideway
- Marginal habitats across Reaches A, B and C in the freshwater River Thames
- Macrophytes across Reaches A, B and C in the freshwater River Thames
- Diatoms across Reaches A, B and C in the freshwater River Thames and Reach E in the estuarine Thames Tideway
- Macroalgae, Angiosperm and Phytoplankton across Reaches D, E and F in the estuarine Thames Tideway
- Designated and protected sites and species across Reaches A, B and C in the freshwater River Thames and Reaches D, E and F in the estuarine Thames Tideway

Where text makes reference to A82 and M96 flow series, respectively these refer to 1 in 5 year and 1 in 20-year flow events.

These assessments have been conducted utilising impact assessments determined within the Physical Environment⁵⁷ and Water Quality⁵⁸ Gate 2 reports.

Summary of physical environment impacts associated with a Teddington DRA scheme

The full assessment of the Gate 2 physical environment impacts of the Teddington DRA schemes includes an assessment of:

- Velocity and flow,
- Outfall design,
- Wetted habitat,
- Fish pass and barrier passability,
- Richmond Pound drawdown, and
- Estuarine sediment.

Table 5-1 shows a high-level summary of these impacts, which are also briefly described as follows.

⁵⁷ Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Physical Environment Assessment Report.

⁵⁸ Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Water Quality Assessment Report.

Velocity and flow

The Teddington DRA scheme is expected to result in moderate impacts (75 MI/d and 50 MI/d scheme sizes) to flow conditions within the Thames, with a 25% to 17% reduction in exceptionally low flows for 250m between intake and outfall.

Outfall design

The potential impacts predicted for outfall design are negligible for both assessed scheme sizes with very negligible changes in water level or velocities modelled between the intake and the outfall.

Wetted habitat

The potential impacts predicted for wetted habitat are negligible for both assessed scheme sizes, with very negligible changes in water level or velocities modelled between the intake and the outfall and negligible changes in exposure of wetted habitat.

Fish pass and barrier passability

The potential impacts predicted for fish pass and barrier passability are negligible for both assessed scheme sizes, with a negligible change in water levels for scheme when compared to baseline under the 75 MI/d scheme size.

Richmond Pound drawdown

The potential impacts predicted for Richmond Pound drawdown are negligible for both assessed scheme sizes, with negligible changes in wetted habitat, water level and suspended sediment concentration.

Estuarine sediment

The potential impacts predicted for estuarine sediment are negligible for both assessed scheme sizes, with negligible changes in wetted habitat, water level and suspended sediment concentration within the estuary.

Table 5-1 Summary of potential physical environment impacts for Teddington DRA schemes

Size	Flow	Outfall and intake design	Wetted habitat	Fish pass and barrier passability	Richmond Pound drawdown	Estuarine sediment
50 MI/d	Moderate 17% reduction in exceptionally low flows for 250m between intake and outfall (300 MI/d upstream of intake)	Negligible change in velocities at intake or outfall inferred from larger scheme modelling assessment of negligible	Negligible change in water level or velocities between intake and outfall inferred from larger scheme modelling assessment of negligible	Negligible water level change inferred from larger scheme modelling assessment of negligible		
75 MI/d	Moderate 25% reduction in exceptionally low flows for 250m between intake and outfall (300 MI/d upstream of intake)	Negligible change in velocities at intake or outfall modelled.	Negligible change in water level or velocities between intake and outfall modelled. Negligible change in wetted habitat.	Negligible water level change modelled	Negligible change in wetted habitat, water level and suspended sediment concentration.	Negligible change in wetted habitat, water level and suspended sediment concentration.
100 MI/d	Major 33% reduction in exceptionally low flows for 250m between intake and outfall (300 MI/d upstream of intake)	Negligible change in velocities at intake or outfall modelled.	Negligible change in water level or velocities between intake and outfall modelled. Negligible change in wetted habitat.	Negligible water level change modelled		
150 MI/d	Major 50% reduction in exceptionally low flows for 250m between intake and outfall (300 MI/d upstream of intake)	Negligible change in velocities at intake or outfall modelled.	Negligible change in water level or velocities between intake and outfall modelled. Negligible change in wetted habitat.	Negligible water level change modelled		

Summary of water quality impacts associated with a Teddington DRA Scheme

The full assessment of the Gate 2 water quality impacts of the Mogden water recycling schemes includes an assessment of:

- Water temperature,
- General physico-chemical,
- WFD chemicals,
- Environmental Quality Standards Directive (EQSD) chemicals,
- Olfactory water quality, and
- Richmond Pound drawdown.

Table 5-2 shows a high-level summary of these impacts, which are also briefly described as follows.

Water temperature

Within the freshwater River Thames, it is predicted that a maximum temperature change of 1.0°C may occur, achieving a maximum modelled temperature of 19.8°C. Negligible impacts are predicted in the Thames Tideway.

General physico-chemical

Within the freshwater River Thames, it is predicted that there may be minor changes in ammoniacal nitrogen within the 150 MI/d, 100 MI/d, 75 MI/d and 50 MI/d scheme size, comprising maximum changes in concentration of 43% (a maximum concentration of 0.07 mg/l, indicative of high status) at Teddington weir. Suspended solids show positive impacts with large decreases in concentration. There are no modelled impacts in dissolved oxygen saturation except at 150MI/d which display a negligible decrease in concentration. Biochemical oxygen demand shows minor increases in concentration (remaining at at least good status) under the 100 MI/d, 75 MI/d and 50 MI/d schemes, with positive impacts displayed at 150 MI/d.

Within the Thames Tideway, it is predicted that there will be a decrease in dissolved inorganic nitrogen under all scheme sizes with negligible impacts to dissolved oxygen.

WFD chemicals

Within the freshwater River Thames minor impacts are predicted with three additional chemicals (Cypermethrin, Hexachlorocyclohexane, Total chlorine) at risk of exceeding the standard (A82) and the same three additional chemicals at risk of exceeding the standard (M96) under the 150 MI/d, 100 MI/d, 75 MI/d and 50 MI/d scheme sizes.

Within the Thames Tideway this will be reduced due to reduced discharge flow rate.

EQSD chemicals

Within the freshwater River Thames negligible impacts are predicted with one additional chemical (Pirimicarb) at risk of exceeding the standard (A82) and no additional chemicals at risk of exceeding the standard (M96) under the 150 MI/d, 100 MI/d, 75 MI/d and 50 MI/d scheme sizes.

Within the Thames Tideway this will be reduced due to reduced discharge flow rate.

Olfactory water quality

Within the freshwater River Thames negligible impacts are predicted with two additional exceedance risks (Pirimicarb, cypermethrin) and one reduced pressure occurring from the reference conditions under the 150 MI/d, 100 MI/d, 75 MI/d and 50 MI/d scheme sizes.

Within the Thames Tideway this will be reduced due to reduced discharge flow rate.

Richmond Pound drawdown

Negligible impacts have been inferred from the Mogden effluent Reuse scheme at 200 MI/d modelling.

Table 5-2 Summary of potential water quality impacts for Teddington DRA schemes

Size	Water temperature	General physico-chemical	WFD chemicals	EQSD chemicals	Olfactory water quality	Richmond Pound Draw Down
50 MI/d	<p>Freshwater Thames: Maximum change 0.7°C</p> <p>Thames Tideway: Negligible impacts</p>	<p>Freshwater Thames: Dissolved oxygen: No change. Ammoniacal Nitrogen: Minor impacts under A82 and M96. BOD: Minor impacts under A82 and M96. Suspended solids: Positive impacts under A82 and M96. ANC: No indication that ANC is affected by scheme in operation. pH: No significant difference. Thames Tideway: DO: Negligible impacts inferred from Mogden effluent Reuse scheme at 200 MI/d modelling DIN: Decrease in concentration during scheme on period, average 58.6 µMol/l (A82) and 51.7 µMol/l (M96).</p>	<p>Freshwater Thames: Eight determinands decreased to be below the standard. 11 continued to exceed standards under the A82 scenario and three new pressures exceeded standards. The same occurs in the M96 scenario with three additional pressures Thames Tideway: Within the Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	<p>Freshwater Thames: Only one determinand exceeds standard under reference conditions and there is one additional pressure under A82 scenario. The changes remained the same under the M96 scenario. Thames Tideway: Within the Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	<p>Freshwater Thames: A82 and M96 both have 10 exceedances with two new pressures and one reduced pressure compared to the reference conditions. Thames Tideway: Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	<p>Negligible impacts inferred from Mogden effluent Reuse scheme at 200 MI/d modelling</p>
75 MI/d	<p>Freshwater Thames: Maximum change 1.1°C</p> <p>Thames Tideway: Negligible impacts</p>	<p>Freshwater Thames: Dissolved oxygen: No change. Ammoniacal Nitrogen: Minor impacts under A82 and M96. BOD: Minor impacts under A82 and M96.</p>	<p>Freshwater Thames: Eight determinands decreased to be below the standard. 11 continued to exceed standards under the A82 scenario and three new pressures exceeded standards. The same occurs in the</p>	<p>Freshwater Thames: Only one determinand exceeds standard under reference conditions and there are two additional pressures under A82 scenario.</p>	<p>Freshwater Thames: A82 and M96 both have 10 exceedances with two new pressures and one reduced pressure compared to the reference conditions.</p>	

Size	Water temperature	General physico-chemical	WFD chemicals	EQSD chemicals	Olfactory water quality	Richmond Pound Draw Down
		<p>Suspended solids: Positive impacts under A82 and M96.</p> <p>ANC: No indication that ANC is affected by scheme in operation.</p> <p>pH: No significant difference.</p> <p>Thames Tideway: DO: Negligible impacts inferred from Mogden effluent Reuse scheme at 200 MI/d modelling DIN: Decrease in concentration during scheme on period, average 55.6 µMol/l (A82) and 48.5 µMol/l (M96).</p>	<p>M96 scenario with three additional pressures</p> <p>Thames Tideway: Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	<p>The changes remained the same under the M96 scenario.</p> <p>Thames Tideway: Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	<p>Thames Tideway: Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	
100 MI/d	<p>Freshwater Thames: Maximum change 1.5°C</p> <p>Thames Tideway: Negligible impacts</p>	<p>Freshwater Thames: Dissolved oxygen: No change. Ammoniacal Nitrogen: Minor impacts under A82 and M96. BOD: Minor impacts under A82 and M96. Suspended solids: Positive impacts under A82 and M96.</p> <p>ANC: No indication that ANC is affected by scheme in operation.</p> <p>pH: No significant difference.</p> <p>Thames Tideway:</p>	<p>Freshwater Thames: Eight determinands decreased to be below the standard. 11 continued to exceed standards under the A82 scenario and three new pressures exceeded standards. The same occurs in the M96 scenario with three additional pressures</p> <p>Thames Tideway: Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	<p>Freshwater Thames: Only one determinand exceeds standard under reference conditions and there is one additional pressures under A82 scenario. The changes remained the same under the M96 scenario.</p> <p>Thames Tideway: Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	<p>Freshwater Thames: A82 and M96 both have 10 exceedances with two new pressures and one reduced pressure compared to the reference conditions.</p> <p>Thames Tideway: Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	

Size	Water temperature	General physico-chemical	WFD chemicals	EQSD chemicals	Olfactory water quality	Richmond Pound Draw Down
		<p>DO: Negligible impacts inferred from Mogden effluent Reuse scheme at 200 MI/d modelling</p> <p>DIN: Decrease in concentration during scheme on period, average 52.5 µMol/l (A82) and 45.3 µMol/l (M96).</p>				
150 MI/d	<p>Freshwater Thames: Maximum change 2.2°C</p> <p>Thames Tideway: Negligible impacts</p>	<p>Freshwater Thames: Dissolved oxygen: Negligible impacts Ammoniacal Nitrogen: Minor impacts under A82 and M96. BOD: Positive impacts under A82 and M96. Suspended solids: Positive impacts under A82 and M96. ANC: No indication that ANC is affected by scheme in operation. pH: No significant difference. Thames Tideway: DO: Negligible impacts inferred from Mogden effluent Reuse scheme at 200 MI/d modelling DIN: Decrease in concentration during scheme on period, average 46.4 µMol/l (A82) and 38.8 µMol/l (M96).</p>	<p>Freshwater Thames: Eight determinands decreased to be below the standard. 11 continued to exceed standards under the A82 scenario and three new pressures exceeded standards. The same occurs in the M96 scenario with three additional pressures Thames Tideway: Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	<p>Freshwater Thames: Only one determinand exceeds standard under reference conditions and there is one additional pressure under A82 scenario. The changes remained the same under the M96 scenario. Thames Tideway: Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	<p>Freshwater Thames: A82 and M96 both have 10 exceedances with two new pressures and one reduced pressure compared to the reference conditions. Thames Tideway: Within the estuarine Thames Tideway this will be reduced due to reduced discharge flow rate.</p>	

5.2 AQUATIC INVERTEBRATES FRESHWATER

5.2.1 Overview

This section sets out the assessment for the freshwater aquatic invertebrates in reaches potentially affected by the Teddington DRA scheme.

- Freshwater River Thames - Section 5.2.2

5.2.2 Freshwater River Thames

Table 5-1 summarises the potential physical environment impacts for each Teddington DRA scheme volume scenarios.

Table 5-2 summarises the potential water quality impacts for each Teddington DRA scheme volume scenarios.

Reach C – Thames Water Walton Intake to Teddington Weir

Velocity and flow impacts upon the invertebrate community

There are negligible effects predicted on wetted habitat, barrier passability and estuarine sediment for both modelled Teddington DRA schemes. Under very low flows a moderate reduction in flow is modelled for 250m of the reach, which may impact the invertebrate community which are somewhat sensitive to reduced flows. Overall, the baseline data suggest that the invertebrate community within the Reach C has a low sensitivity to velocity changes and a preference for moderate flowing waters. Given the relatively short area of likely impact within this section of the freshwater River Thames, the associated changes in flow are not considered to be significant enough to result in a noticeable or measurable change in the invertebrate community, as the community's preferred habitats of a generally uniform, slow and deep nature will be retained.

Temperature impacts upon the invertebrate community

The impacts summarised above on the freshwater River Thames are not likely to exceed the tolerable range of any of the species found within the reach. There is a possibility that temperature increases of up to 0.98 °C across the reach (higher in immediate vicinity of the outfall) such as those predicted above may potentially improve the fitness of individual invertebrate species currently present. Temperature increases are likely to increase the metabolic rates for all of the species present which may increase growth rates, fecundity or spawning periods, particularly for species close to their climatic range. However, as previously discussed, the realised impact on individual invertebrate preference resulting from relatively small changes to the physical environment cannot be predicted accurately as they are reliant upon numerous biotic and abiotic factors.

Oxygen Saturation impacts upon the invertebrate community

Negligible changes in dissolved oxygen are unlikely to result in any change in biological fitness overall for the invertebrate community.

pH impacts upon the invertebrate community

Negligible changes to pH are unlikely to result in any change in biological fitness overall for the invertebrate community.

5.3 AQUATIC INVERTEBRATES ESTUARINE

5.3.1 Overview

This section sets out the assessment for the estuarine aquatic invertebrates in reaches potentially affected by the Teddington DRA scheme.

- Estuarine Thames Tideway - Section 5.3.2

5.3.2 Estuarine Thames Tideway

Table 5-1 summarises the potential physical environment impacts for each Teddington DRA scheme volume scenarios.

Table 5-2 summarises the potential water quality impacts for each Teddington DRA scheme volume scenarios.

Reach D – Teddington Weir to Battersea Park

Velocity and flow impacts upon the invertebrate community

There is no impact expected on velocity and flow on Reach D.

Temperature impacts upon the invertebrate community

It is noted that there would be temperature changes in the estuarine Thames Tideway as consequence of a Teddington DRA scheme associating with less discharge of final effluent from Mogden STW. These temperature reductions are unlikely to have any impacts on the invertebrate communities. The minor increases in temperature as predicted local to Teddington weir are unlikely cause the temperature to exceed the tolerable range of any of the species present within the reach. There is a possibility that temperature increases may potentially improve the fitness of individual invertebrates currently present resulting in a competitive advantage. Temperature increases are likely to increase the metabolic rates for all of the species listed which may increase growth rates, fecundity or spawning periods, particularly for species close to their climatic range.

Dissolved oxygen impacts upon the invertebrate community

It is noted that there would be dissolved oxygen changes in the estuarine Thames Tideway as consequence of a Teddington DRA scheme associating with less discharge of final effluent from Mogden STW. That assessment of estuarine dissolved oxygen is modelled for a 200 MI/d Mogden water recycling scheme and impacts from a 150 MI/d, 100 MI/d, 75 MI/d or 50 MI/d Teddington DRA scheme are proportionately less than those predicted through the reported modelling. Though the increases in dissolved oxygen may result in a general improvement in biological fitness overall, the minor increases of a maximum of 1% are not likely to result in impacts to the invertebrate community within the estuarine Thames Tideway.

Dissolved inorganic nitrogen impacts upon the invertebrate community

It is predicted that there will be a decrease in DIN in the estuarine Thames Tideway, this is not expected to negatively impact the invertebrate community the invertebrate community as the community has been determined to be tolerant to a wide range of nutrient conditions.

Reach E – Battersea Park to Tower Bridge

There are no data available to make an assessment on aquatic invertebrates in Reach E.

Reach F Tower Bridge to 3km seawards of Beckton STW

There are no data available to make an assessment on aquatic invertebrates in Reach F.

5.4 MARGINAL HABITAT ASSESSMENT

5.4.1 Overview

This section sets out the assessment for the marginal habitats in reaches potentially affected by the Teddington DRA scheme.

- Freshwater River Thames - Section 5.4.2

The assessment on impacts to the RCA are based on outputs from the physical environment assessment report⁵⁹, INNS Report⁶⁰, and macrophyte assessment (Section 5.5).

In summary, there is a predicted moderate (25%) reduction in exceptionally low flows for 250m between the intake and outfall locations. Negligible changes in velocity, water level, wetted habitat. The assessment assumes Scenario 1 (300 MI/d at 200 MI/d discharge) from Physical Environment Report. A full summary of predicted physical environment impacts is detailed in Section 5.1, Table 5-1.

⁵⁹ Ricardo Energy & Environment. (2022). *London Effluent Reuse SRO. Aquatic Physical Environment Assessment Report Draft 2.0*. Ref. 4700399659. Ricardo ref. ED13591.

⁶⁰ Ricardo Energy & Environment. (2022). *London Effluent Reuse SRO. INNS Assessment Report Draft 1.0*. Ref. 4700399659. Ricardo ref. ED13591.

5.4.2 Freshwater River Thames

Reach C – Thames Water Walton Intake to Teddington Weir

The assessed changes in river condition indicators for RCAs within Reach C are presented in Table 4-3.

TR_05, TR_06 are located approximately 6.9 km and 6.3 km upstream of the Teddington DRA intake/discharge points on the freshwater River Thames. TR_07 is located on a side channel of the freshwater River Thames, to the west of Trowlock Island and is unaffected by this scheme. Therefore, there are no assessed changes to these RCA.

Although there will be the addition of artificial bank face structures (intake and outfall structures) within the section of the river covered by TR_08, river condition indicators C7-C9 were assessed to be no change as the bank face in these locations are already modified channels (Table 5-3).

River condition indicator E3, channel bed hydraulic features, was assessed to increase in the section of the river covered by TR_08 in this reach due to the intake and discharge points which has been shown to alter flow patterns, introducing more diversity of flow immediately within the 250m section. River condition indicator E11 has been assessed to alter for TR_08 to reflect the outcome of the INNS assessment (Table 5-3).

Due to negligible predicted changes in wetted width, there are no assessed changes to the channel margin natural indicators, i.e., river condition indicators D1-D4.

There is no assessed change to indicators for TR_05, TR_06, and TR_07 based on the operation of this scheme.

The assessed changes to the indicator scores for TR_08 were both positive (increased hydraulic feature richness) and negative (increased NNIPS extent). Overall, the preliminary condition score was reduced to -0.753, however this change does not meet the lower threshold and the condition category for Poor for this river type, and therefore remains Fairly poor river condition category.

Table 5-3 Assessed changes in river condition indicators of Reach C during operation of the 150 Ml/d Teddington DRA scheme. Green shading indicates a positive change (i.e., a higher positive score or a lower negative score), and red shading indicates a negative change (i.e., a lower positive score or a higher negative score). '-' in the operational column indicates no change to the baseline score

Code	Indicator name	Positive / Negative type	TR_05 baseline	TR_05 operational	TR_06 baseline	TR_06 operational	TR_07 baseline	TR_07 operational	TR_08 baseline	TR_08 operational
B1	Bank top vegetation structure	Positive	3	-	2	-	2	-	2	-
B2	Bank top tree feature richness	Positive	0	-	0	-	0	-	0	-
B3	Bank top water related features	Positive	0	-	2	-	2	-	2	-
B4	Bank top NNIPS cover	Negative	0	-	0	-	0	-	0	-
B5	Bank top managed ground cover	Negative	-4	-	-3	-	-4	-	-4	-
C1	Bank face riparian vegetation structure	Positive	2	-	3	-	1	-	2	-
C2	Bank face tree feature richness	Positive	0	-	2	-	1	-	1	-
C3	Bank face natural bank profile extent	Positive	0	-	0	-	0	-	0	-
C4	Bank face natural bank profile richness	Positive	0	-	0	-	0	-	0	-
C5	Bank face natural bank material richness	Positive	1	-	1	-	0	-	1	-
C6	Bank face bare sediment extent	Positive	0	-	1	-	0	-	1	-
C7	Bank face artificial bank profile extent	Negative	-4	-	-4	-	-4	-	-4	-
C8	Bank face reinforcement extent	Negative	-4	-	-4	-	-4	-	-4	-
C9	Bank face reinforcement material severity	Negative	4	-	-4	-	-4	-	-4	-
C10	Bank face NNIPS cover	Negative	0	-	0	-	0	-	0	-
D1	Channel margin aquatic vegetation extent	Positive	0	-	1	-	0	-	1	-
D2	Channel margin aquatic morphotype richness	Positive	0	-	0	-	0	-	1	-
D3	Channel margin physical feature extent	Positive	0	-	1	-	0	-	0	-
D4	Channel margin physical feature richness	Positive	0	-	1	-	0	-	0	-
D5	Channel margin artificial features	Negative	-3	-	-2	-	0	-	-1	-
E1	Channel bed aquatic morphotype richness	Positive	0	-	0	-	0	-	0	-

Code	Indicator name	Positive / Negative type	TR_05 baseline	TR_05 operational	TR_06 baseline	TR_06 operational	TR_07 baseline	TR_07 operational	TR_08 baseline	TR_08 operational
E2	Channel bed tree features richness	Positive	0	-	0	-	1	-	0	-
E3	Channel bed hydraulic features richness	Positive	3	-	0	-	0	-	0	1
E4	Channel bed natural features extent	Positive	0	-	0	-	0	-	0	-
E5	Channel bed natural features richness	Positive	0	-	0	-	0	-	0	-
E6	Channel bed material richness	Positive	0	-	0	-	0	-	0	-
E7	Channel bed siltation	Negative	0	-	0	-	0	-	0	-
E8	Channel bed reinforcement extent	Negative	0	-	0	-	0	-	0	-
E9	Channel bed reinforcement severity	Negative	0	-	0	-	0	-	0	-
E10	Channel bed artificial features severity	Negative	-4	-	0	-	0	-	0	-
E11	Channel bed NNIPS extent	Negative	0	-	0	-	0	-	0	-1
E12	Channel bed filamentous algae extent	Negative	0	-	0	-	0	-	0	-
Preliminary condition score:			-1.296	No change	-0.571	No change	-0.862	No change	-0.729	-0.753
River condition category:			Poor	No change	Fairly Poor	No change	Fairly Poor	No change	Fairly Poor	Fairly Poor

5.5 MACROPHYTES

5.5.1 Overview

This section sets out the assessment for the macrophyte communities in reaches potentially affected by the Teddington DRA scheme.

- Freshwater Thames – Section 5.5.2

5.5.2 Freshwater River Thames

Reach C – Thames Water Walton Intake to Teddington Weir

Velocity and flow impacts upon the macrophyte community

Velocities during exceptionally low flows are likely to decrease by 17% and 25% for the 250m between the intake and outfall. This relevantly short section of the reach therefore has the potential to have an adverse impact on those macrophytes which are already close to their tolerance for low flows.

Temperature impacts upon the macrophyte community

There is a possibility that during operation temperatures may increase by up to 0.98°C, with higher temperature in the immediate vicinity of the outfall. Changes in temperature can have both beneficial and negative effect of individual macrophyte species. It is possible that by increasing temperature, there will be a reduction in optimum conditions for macrophyte species. Therefore, those macrophyte species with a higher temperature tolerance may thrive. As a result, the potential changes in temperature will likely not impact on availability, quantity and quality of habitat within the reaches.

Oxygen Saturation impacts upon the macrophyte community

No impacts on dissolved oxygen saturation are expected within this reach.

pH impacts upon the macrophyte community

The minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the macrophytes communities. Therefore, there is predicted to be no impact on macrophyte communities within the freshwater River Thames due to the scheme.

5.6 DIATOMS

5.6.1 Overview

This section sets out the assessment for the plants/diatoms in reaches potentially affected by the Teddington DRA scheme.

- Freshwater River Thames - Section 5.6.2
- Estuarine Thames Tideway – Section 5.6.3

5.6.2 Freshwater River Thames

Table 5-1 summarises the potential physical environment impacts for each Teddington DRA scheme volume scenarios.

Table 5-2 summarises the potential water quality impacts for each Teddington DRA scheme volume scenarios.

Reach C – Thames Water Walton Intake to Teddington Weir

Velocity and flow impacts upon the diatom community

Velocities during exceptionally low flows are likely to decrease by 17% and 25% for the 250m between the intake and outfall. This relevantly short section of the reach therefore has the potential to have an adverse impact on those diatom communities with low motility.

All benthic diatom taxa are divided into three diatom ecological guilds based on growth morphologies and their ability to tolerate nutrient limitation and physical disturbance, i.e., low-profile, high-profile, and motile guilds⁴⁵⁴⁶. The low-profile guild comprises diatom taxa of short stature that are predominantly attached to substrate.

Diatom taxa belonging to the high-profile guild are larger or tend to form long colonies or stalks. The motile guild comprises comparatively fast-moving species. Diatoms with high motility are able to move with flows, whereas those with low motility cannot. The low-profile guild are known to dominate at high current velocities, whereas the high-profile guild prevails in low velocities resulting in low guild diversity at both ends of the current velocity gradient.

From the samples collected within this reach, all sites recorded varied results regarding mean motility percentage. The highest mean score was recorded at LRUS-006, which suggests the community here is less likely to be impacted by reducing flows when compared to other sites in the reach. Overall, the motility is relatively low, and therefore diatoms in this reach are likely to be affected in areas whereby there is a reduction in flows.

Though there is a reduction in velocities within the lower section of the reach (i.e. the DRA intake), any impact within the 250m between the intake and outfall is likely to be short-term reversible and is not likely to have an overall impact on the reaches diatom communities.

Temperature impacts upon the diatom community

There is a possibility that during operation temperatures may increase by up to 0.98°C. Changes in temperature can have both beneficial and negative effect of individual diatom species. It is possible that by increasing temperature, there will be a reduction in optimum conditions for diatom species. Increasing temperatures have also been found to slow or stop division rates within diatom species when upper tolerances have been reached. Therefore, those diatom species with a higher temperature tolerance may outcompete other species.

The results give evidence that the potential change in temperatures is not considered likely to be outside the preferred thermal range for the diatom communities within the River Thames and will likely be within the inter annual variations that would be observed under reference conditions. As a result, the potential changes in temperature will likely not impact on availability, quantity and quality of habitat within the reaches.

Oxygen Saturation impacts upon the diatom community

No impacts on dissolved oxygen saturation are expected within this reach.

pH impacts upon the diatom community

The minimal predicted change in pH within the freshwater River Thames is not likely to result in conditions exceeding the pH preference of any of the diatoms communities. Therefore, there is predicted to be no impact on diatom communities within the freshwater River Thames due to the scheme.

5.6.3 Estuarine Thames Tideway

Table 5-1 summarises the potential physical environment impacts for each Teddington DRA scheme volume scenarios.

Table 5-2 summarises the potential water quality impacts for each Teddington DRA scheme volume scenarios.

Reach D – Teddington Weir to Battersea Park

There are no data available to make an assessment on diatoms within Reach D.

Reach E – Battersea Park to Tower Bridge

Velocity and flow impacts upon the diatom community

No impacts on flow or velocity are expected within this reach.

Temperature impacts upon the diatom community

Negligible impacts on temperature are predicted.

Dissolved oxygen impacts upon the diatom community

Negligible impacts on dissolved oxygen are predicted.

Dissolved inorganic nitrogen impacts upon the diatom community

Significant decreases in DIN are predicted for the estuarine Thames Tideway, this is not expected to impact the diatom community as the community has been determined to be tolerant to a moderate to low organic

pollution. However, the reduction in DIN may increase the presence of more sensitive diatom species during scheme on periods.

Reach F Tower Bridge to 3km seawards of Beckton STW

There are no data available to make an assessment on diatoms within Reach F.

5.7 MACROALGAE, ANGIOSPERM AND PHYTOPLANKTON

5.7.1 Overview

This section sets out the assessment for the macroalgae, angiosperm and phytoplankton in reaches potentially affected by the Teddington DRA scheme. It should be noted that marine angiosperms are not present within the upper and middle Thames Tideway and that known beds are circa 120km down river of Teddington Weir.

- Estuarine Thames Tideway – Section 5.7.2

5.7.2 Estuarine Thames Tideway

Table 5-1 summarises the potential physical environment impacts for each Teddington DRA scheme volume scenarios.

Table 5-2 summarises the potential water quality impacts for each Teddington DRA scheme volume scenarios.

Reach D – Teddington Weir to Battersea Park

Velocity and flow impacts upon the macroalgae and phytoplankton community

No impacts on flow or velocity are expected within this reach.

Temperature impacts upon the macroalgae and phytoplankton community

Negligible impacts on temperature are predicted.

Dissolved oxygen impacts upon the macroalgae and phytoplankton community

Negligible impacts on dissolved oxygen are predicted.

Dissolved inorganic nitrogen impacts upon the macroalgae and phytoplankton community

Decreases in DIN are predicted for the estuarine Thames Tideway, this is not expected to impact the macroalgal community as the community has been determined to be in an impacted state. However, the reduction in DIN may increase the presence of more sensitive macroalgal species. It is also considered that a reduction in DIN will not negatively impact the phytoplankton community, which is in an unimpacted state, as DIN reductions are likely to increase the fitness of the community.

Reach E – Battersea Park to Tower Bridge

There are no data available to make an assessment on macroalgae within Reach E.

Reach F Tower Bridge to 3km seawards of Beckton STW

There are no data available to make an assessment on macroalgae within Reach F.

5.8 DESIGNATED AND PROTECTED SITES AND SPECIES

5.8.1 Overview

This section sets out the assessment for the designated and protected sites and species in reaches potentially affected by the Teddington DRA scheme.

- Freshwater River Thames - Section 5.8.2
- Estuarine Thames Tideway – Section 5.8.3

5.8.2 Freshwater River Thames

Table 5-1 summarises the potential physical environment impacts for each Teddington DRA scheme volume scenarios.

Table 5-2 summarises the potential water quality impacts for each Teddington DRA scheme volume scenarios.

Dumsey Meadow SSSI

The site borders the freshwater River Thames but is located 1.88 km west and 3.3 km upstream of the freshwater River Thames reach. Therefore, there is no potential for impacts to the qualifying features of Dumsey Meadow SSSI due to hydrological or water quality changes associated with the Teddington DRA.

Chertsey Meads LNR

The site borders the freshwater River Thames but is located 1.02 km west and 2.15 km upstream of the freshwater River Thames reach. Therefore, due to the lack of impact pathways there is no potential for impacts to the qualifying features of Chertsey Meads LNR due to hydrological or water quality changes associated with the Teddington DRA.

Ash Link LNR

The LNR is located 1.85km north of the freshwater River Thames reach. The site borders the River Ash which is upstream of the River Thames and therefore not hydrologically dependent on the freshwater River Thames reach for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are highly unlikely.

Knight & Bessborough Reservoirs SSSI

The reservoirs are located over 0.55 km from the freshwater River Thames and are not hydrologically dependent on the freshwater River Thames reach for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the SSSI are highly unlikely.

Kempton Park Reservoirs SSSI and LNR

The reservoirs are located over 1.22 km north of the freshwater River Thames and are not hydrologically dependent on the freshwater River Thames reach for water level or water quality. Kempton Park Reservoir East is not operational and is managed as a nature reserve. Therefore, due to the distance and absence of impact pathways potential impacts to the SSSI are considered to be highly unlikely.

Molesey Heath LNR

The LNR is 1.46 km south of the freshwater River Thames adjacent to the River Mole. Due to the distance, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the freshwater River Thames reach for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Bushy Park and Home Park SSSI

The SSSI is located only 0.03 km from the freshwater River Thames however the site is not designated for water dependent features and is not reliant on the level, flow, or water quality of the freshwater River Thames reach for maintenance of site condition. Therefore, due to the absence of impact pathways, potential impacts to the SSSI are considered to be highly unlikely.

Stokes field LNR

The LNR is 1.12 km south of the freshwater River Thames with no hydrological connectivity to the site. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Oak Hill Woods LNR

The LNR is located 1 km south of the freshwater River Thames with no hydrological connectivity (site is above the level of the river) to the site. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Richmond Park SSSI, NNR, and LNR

Richmond Park is located over 1.25 km from the freshwater River Thames reach and is not designated for water dependent features. Therefore, it is not reliant on the level, flow, or water quality of the River Thames for maintenance of site condition. Therefore, due to the absence of impact pathways, potential impacts to the SSSI are considered to be highly unlikely.

Ham Common LNR

The LNR is 0.85 km east of the freshwater River Thames with no hydrological connectivity to the site. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Oak Avenue Hampton LNR

The LNR is located 1.91km north of the freshwater River Thames and is not designated for water dependent features. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered to be highly unlikely.

Ham Lands LNR

The potential impacts on this site are outlined in Section 5.8.3.

A summary of potential impacts to the designated sites within 2km of the freshwater River Thames is shown in Table 5-4.

Table 5-4 Teddington DRA designated site impact assessment summary for the freshwater River Thames

Site Name	Potential impacts	Further assessment required
Dumsey Meadows SSSI	No potential impacts identified	No
Chertsey Meadow LNR	No potential impacts identified	No
Ash Link LNR	No potential impacts identified	No
Knight & Bessborough Reservoirs SSSI	No potential impacts identified	No
Southwest London Waterbodies SPA	No potential impacts identified	No
Southwest London Waterbodies Ramsar	No potential impacts identified	No
Kempton Park Reservoirs SSSI	No potential impacts identified	No
Kempton Park LNR	No potential impacts identified	No
Molesey Heath LNR	No potential impacts identified	No
Bushy Park and Home Park SSSI	No potential impacts identified	No
Stokes field LNR	No potential impacts identified	No
Oak Hill Woods LNR	No potential impacts identified	No
Richmond Park SSSI, NNR, and LNR	No potential impacts identified	No
Ham Common LNR	No potential impacts identified	No
Oak Avenue Hampton LNR	No potential impacts identified	No

5.8.3 Estuarine Thames Tideway

Table 5-1 summarises the potential physical environment impacts for each Teddington DRA scheme volume scenarios.

Table 5-2 summarises the potential water quality impacts for each Teddington DRA scheme volume scenarios.

Bushy Park and Home Park SSSI

The SSSI is located only 0.03 km from the freshwater River Thames (and slightly further from the start of the Richmond Pound) however the site is not designated for water dependent features and is not reliant on the level, flow, or water quality of the estuarine Thames Tideway for maintenance of site condition. Therefore, due to the absence of impact pathways, potential impacts to the SSSI are considered highly unlikely.

Richmond Park SSSI, NNR, and LNR

Richmond Park is located over 0.5 km from the estuarine Thames Tideway and is not designated for water dependent features. Therefore, it is not reliant on the level, flow, or water quality of the estuarine Thames

Tideway for maintenance of site condition. Therefore, due to the absence of impact pathways, potential impacts to the SSSI are considered highly unlikely.

Ham Common LNR

The LNR is 1.35 km east of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Ham Lands LNR

The LNR is located adjacent to the estuarine Thames Tideway, however, the physical environment and water quality assessments identified negligible changes in water level, intertidal exposure and water quality throughout the reach. Therefore, negative impacts to the Ham Lands LNR arising from the Teddington DRA are considered highly unlikely.

Isleworth Ait LNR

The LNR is located within the estuarine Thames Tideway, however, the physical environment and water quality assessments identified negligible changes in water level, intertidal exposure and water quality throughout the reach. Therefore, negative impacts to the Isleworth Ait LNR arising from the Teddington DRA are considered highly unlikely.

Syon Park SSSI

The LNR is located adjacent to the estuarine Thames Tideway, however, the physical environment and water quality assessments identified negligible changes in water level, intertidal exposure and water quality throughout the reach. Therefore, negative impacts to the Syon Park SSSI arising from the Teddington DRA are considered highly unlikely.

Blondin Park, Northfields LNR

The LNR is 1.77 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Gunnersbury Triangle LNR

The LNR is 0.98 km east of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Barn Elms Wetland Centre SSSI

The Barn Elms Wetland Centre SSSI is fed by water pumped from the Thames-Lee tunnel, with the water entering the site through the Reservoir lagoon and returning to the estuarine Thames Tideway via a tidal flap at low tide. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from Teddington DRA, no impacts to the Barn Elms Wetland Centre SSSI are anticipated.

Barnes Common LNR

The LNR is 0.65 km west of the estuarine Thames Tideway with no hydrological connectivity to the site. Due to the distance from the site, water dependent habitats and species in the site are highly unlikely to be hydrologically dependent on the estuarine Thames Tideway for water level or water quality. Therefore, due to the distance and absence of impact pathways, potential impacts to the LNR are considered highly unlikely.

Duke's Hollow LNR

The LNR is located adjacent to the estuarine Thames Tideway, however, the physical environment and water quality assessments identified negligible changes in water level, intertidal exposure and water quality throughout the reach. Therefore, negative impacts to the Duke's Hollow LNR arising from Teddington DRA are considered highly unlikely.

Chiswick Eyot LNR

The LNR is located within the estuarine Thames Tideway, however, the physical environment and water quality assessments identified negligible changes in water level, intertidal exposure and water quality throughout the reach. Therefore, negative impacts to the Chiswick Eyot LNR arising from Teddington DRA are considered highly unlikely.

Leg of Mutton Reservoir LNR

The reservoir is adjacent to the estuarine Thames Tideway; however, it is level controlled via sluice gates. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Leg of Mutton Reservoir LNR are anticipated.

Battersea Park Nature Areas LNR

The LNR is located only 0.07 km south of the estuarine Thames Tideway, however, there is no known hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Battersea Park Nature Areas LNR are anticipated.

Lavender Pond LNR

The pond is connected to the estuarine Thames Tideway by Lavender Dock, however, it is level controlled. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Lavender Pond LNR are anticipated.

Russia Dock Woodland LNR

The ponds and wetlands are not connected to the estuarine Thames Tideway and are likely to be surface water fed. The site is separated from the river by the level-controlled Greenland Dock. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Russia Dock Woodland LNR are anticipated.

Mudchute Park Farm LNR

The LNR is located 0.26 km east of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Mudchute Park Farm LNR are anticipated.

Tower Hamlets Cemetery Park LNR

The LNR is located 1.4 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Tower Hamlets Cemetery Park LNR are anticipated.

Ackroyd Drive Greenlink LNR

The LNR is located 1.4 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Ackroyd Drive Greenlink LNR are anticipated.

Sue Godfrey Nature Park LNR

The LNR is located 0.5 km south of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Sue Godfrey Nature Park LNR are anticipated.

Gilbert's Pit (Charlton) SSSI and Maryon Wilson Park & Gilbert's Pit LNR

The SSSI is of interest for geological formations and will not be affected by hydrological changes in the estuarine Thames Tideway due to the distance to the site and absence of connectivity. The LNR is located 0.5 km south of the River Thames with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to these sites are anticipated.

Crossness LNR

The site borders the estuarine Thames Tideway but is located 1.0 km east and downstream of the estuarine Thames Tideway reach. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Crossness LNR are anticipated.

Ripple LNR

The LNR is located 0.6 km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Ripple LNR are anticipated.

Stave Hill Ecology Park LNR

The ponds within the LNR are not connected to the estuarine Thames Tideway and are likely to be surface water fed. The site is separated from the river by the level-controlled Greenland Dock. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Stave Hill Ecology Park LNR are anticipated.

Brookmill Road LNR

The LNR is located 1.65km south of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Brookmill Road LNR are anticipated.

Scrattons Ecopark and Extension LNR

The LNR is 1.26km north of the estuarine Thames Tideway with no hydrological connectivity to the site. Therefore, due to an absence of impact pathways and negligible impacts on water level resulting from the Teddington DRA, no impacts to the Scrattons Ecopark and Extension LNR are anticipated.

A summary of potential impacts to the designated sites within 2km of the estuarine Thames Tideway is shown in Table 5-5.

Table 5-5 Teddington DRA designated site impact assessment summary for the estuarine Thames Tideway

Site Name	Potential impacts	Further assessment required
Bushy Park and Home Park SSSI	No potential impacts identified	No
Richmond Park SSSI, NNR, and LNR	No potential impacts identified	No
Ham Common LNR	No potential impacts identified	No
Ham Lands LNR	No potential impacts identified	No
Isleworth Ait LNR	No potential impacts identified	No
Syon Park SSSI	No potential impacts identified	No
Blondin Park, Northfields LNR	No potential impacts identified	No
Gunnersbury Triangle LNR	No potential impacts identified	No
Barn Elms Wetland Centre SSSI	No potential impacts identified	No
Barnes Common LNR	No potential impacts identified	No
Duke's Hollow LNR	No potential impacts identified	No
Chiswick Eyot LNR	No potential impacts identified	No
Leg of Mutton Reservoir LNR	No potential impacts identified	No
Battersea Park Nature Areas LNR	No potential impacts identified	No
Lavender Pond LNR	No potential impacts identified	No
Russia Dock Woodland LNR	No potential impacts identified	No
Mudchute Park Farm LNR	No potential impacts identified	No

Site Name	Potential impacts	Further assessment required
Tower Hamlets Cemetery Park LNR	No potential impacts identified	No
Ackroyd Drive Greenlink LNR	No potential impacts identified	No
Sue Godfrey Nature Park LNR	No potential impacts identified	No
Gilbert's Pit (Charlton) SSSI	No potential impacts identified	No
Maryon Wilson Park & Gilbert's Pit LNR	No potential impacts identified	No
Crossness LNR	No potential impacts identified	No
Ripple LNR	No potential impacts identified	No
Stave Hill Ecology Park LNR	No potential impacts identified	No
Brookmill Road LNR	No potential impacts identified	No
Scrattons Ecopark and Extension LNR	No potential impacts identified	No

5.9 SUMMARY OF AQUATIC ECOLOGY ASSESSMENT OF THE TEDDINGTON DRA SCHEME

Table 5-6 summarises the potential aquatic ecology impacts for each of the sizes of a Teddington DRA scheme.

Table 5-6 Summary of potential aquatic ecology impacts for Teddington DRA scheme

Size	Aquatic invertebrates freshwater	Aquatic invertebrates estuarine	Marginal habitat assessment	Macrophytes	Diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species
50 MI/d	Negligible aquatic invertebrates freshwater inferred from larger schemes	Negligible aquatic invertebrates estuarine inferred from larger schemes	Negligible marginal habitats inferred from larger schemes	Negligible macrophytes inferred from larger schemes	Negligible diatoms inferred from larger schemes	Negligible macroalgae, angiosperm and phytoplankton inferred from larger schemes	Negligible designated and protected sites and species inferred from larger schemes
75 MI/d	<p>Velocity and flow: No impact expected.</p> <p>Temperature: Temperature increase not likely to exceed tolerable range. Possible increase in metabolic rates of species present.</p> <p>Oxygen saturation: No impact expected.</p> <p>pH: No impact expected.</p>	<p>Velocity and flow: No impact expected.</p> <p>Temperature: Temperature increase not likely to exceed tolerable range. Possible increase in metabolic rates of species present.</p> <p>Dissolved oxygen: Minor increase in dissolved oxygen not expected to have a significant impact on invertebrates.</p> <p>Dissolved inorganic nitrogen: Decrease in DIN not expected to have a significant impact on invertebrates.</p>	<p>Freshwater River Thames No assessed change to indicators TR_05, TR_06 or TR_07.</p> <p>Positive increase in hydraulic feature richness for TR_08. Minor negative impact due to increased NNIPS extent for TR_08. Overall decrease in preliminary condition score but remains in the 'Fairly poor' category.</p>	<p>Velocity and flow: Potential adverse impact on macrophyte species already close to tolerance threshold for low flows in the 250m between intake and outfall.</p> <p>Temperature: Temperature increase will favour macrophytes with greater tolerance range.</p> <p>Oxygen saturation: No impacts expected.</p> <p>pH: pH increase not likely to exceed tolerable range. No impacts expected.</p>	<p>Freshwater Thames: Velocity and flow: Reduction in velocities in 250m between outfall and intake. Diatoms with low motility have potential to be negatively impacted by reduced flows. Impacts short term, reversible and localised.</p> <p>Temperature: Temperature increase may favour diatoms with a greater tolerance range. Temperature change is not considered outside of normal inter annual variations and therefore no impacts are expected.</p> <p>Oxygen saturation: No impacts expected.</p> <p>pH: pH increase not likely to exceed tolerable range. No impacts expected.</p>	<p>Negligible macroalgae, angiosperm and phytoplankton impact.</p>	<p>Freshwater Thames: No potential impacts identified.</p> <p>Thames Tideway: No potential impacts identified.</p>

Size	Aquatic invertebrates freshwater	Aquatic invertebrates estuarine	Marginal habitat assessment	Macrophytes	Diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species
					<p>Thames Tideway:</p> <p>Velocity and flow: No impact expected.</p> <p>Temperature: Negligible impacts on temperature are predicted.</p> <p>Dissolved oxygen: Negligible impacts on dissolved oxygen are predicted.</p> <p>Dissolved inorganic nitrogen: Decrease in DIN not expected to have a significant impact on diatoms.</p>		
100 MI/d	<p>Velocity and flow: No impact expected.</p> <p>Temperature: Temperature increase not likely to exceed tolerable range. Possible increase in metabolic rates of species present.</p> <p>Oxygen saturation: No impact expected.</p> <p>pH: No impact expected.</p>	<p>Velocity and flow: No impact expected.</p> <p>Temperature: Temperature increase not likely to exceed tolerable range. Possible increase in metabolic rates of species present.</p> <p>Dissolved oxygen: Minor increase in dissolved oxygen not expected to have a significant impact on invertebrates.</p>	<p>No assessed change to indicators TR_05, TR_06 or TR_07.</p> <p>Positive increase in hydraulic feature richness for TR_08. Minor negative impact due to increased NNIPS extent for TR_08. Overall decrease in preliminary condition score but remains in the 'Fairly poor' category.</p>	<p>Velocity and flow: Potential adverse impact on macrophyte species already close to tolerance threshold for low flows in the 250m between intake and outfall.</p> <p>Temperature: Temperature increase will favour macrophytes with greater tolerance range.</p> <p>Oxygen saturation: No impacts expected.</p>	<p>Freshwater Thames:</p> <p>Velocity and flow: Reduction in velocities in 250m between outfall and intake. Diatoms with low motility have potential to be negatively impacted by reduced flows. Impacts short term, reversible and localised.</p> <p>Temperature: Temperature increase may favour diatoms with a greater tolerance range. Temperature change is not considered outside of normal inter annual variations and therefore no impacts are expected.</p>	<p>Negligible macroalgae, angiosperm and phytoplankton impact.</p>	<p>Freshwater Thames: No potential impacts identified.</p> <p>Thames Tideway: No potential impacts identified.</p>

Size	Aquatic invertebrates freshwater	Aquatic invertebrates estuarine	Marginal habitat assessment	Macrophytes	Diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species
		Dissolved inorganic nitrogen: Decrease in DIN not expected to have a significant impact on invertebrates.		pH: pH increase not likely to exceed tolerable range. No impacts expected.	Oxygen saturation: No impacts expected. pH: pH increase not likely to exceed tolerable range. No impacts expected. Thames Tideway: Velocity and flow: No impact expected. Temperature: Negligible impacts on temperature are predicted. Dissolved oxygen: Negligible impacts on dissolved oxygen are predicted. Dissolved inorganic nitrogen: Decrease in DIN not expected to have a significant impact on diatoms.		
150 MI/d	Velocity and flow: No impact expected. Temperature: Temperature increase not likely to exceed tolerable range. Possible increase in	Velocity and flow: No impact expected. Temperature: Temperature increase not likely to exceed tolerable range. Possible increase in	No assessed change to indicators TR_05, TR_06 or TR_07. Positive increase in hydraulic feature richness for TR_08. Minor negative impact due to	Velocity and flow: Potential adverse impact on macrophyte species already close to tolerance threshold for low flows in the 250m between intake and outfall.	Freshwater Thames: Velocity and flow: Reduction in velocities in 250m between outfall and intake. Diatoms with low motility have potential to be negatively impacted by reduced flows. Impacts short term, reversible and localised.	Negligible macroalgae, angiosperm and phytoplankton impact.	Freshwater Thames: No potential impacts identified. Thames Tideway: No potential impacts identified.

Size	Aquatic invertebrates freshwater	Aquatic invertebrates estuarine	Marginal habitat assessment	Macrophytes	Diatoms	Macroalgae, angiosperm and phytoplankton	Designated and protected sites and species
	<p>metabolic rates of species present.</p> <p>Oxygen saturation: No impact expected.</p> <p>pH: No impact expected.</p>	<p>metabolic rates of species present.</p> <p>Dissolved oxygen: Minor increase in dissolved oxygen not expected to have a significant impact on invertebrates.</p> <p>Dissolved inorganic nitrogen: Decrease in DIN not expected to have a significant impact on invertebrates.</p>	<p>increased NNIPS extent for TR_08. Overall decrease in preliminary condition score but remains in the 'Fairly poor' category.</p>	<p>Temperature: Temperature increase will favour macrophytes with greater tolerance range.</p> <p>Oxygen saturation: No impacts expected.</p> <p>pH: pH increase not likely to exceed tolerable range. No impacts expected.</p>	<p>Temperature: Temperature increase may favour diatoms with a greater tolerance range. Temperature change is not considered outside of normal inter annual variations and therefore no impacts are expected.</p> <p>Oxygen saturation: No impacts expected.</p> <p>pH: pH increase not likely to exceed tolerable range. No impacts expected.</p> <p>Thames Tideway: Velocity and flow: No impact expected.</p> <p>Temperature: Negligible impacts on temperature are predicted.</p> <p>Dissolved oxygen: Negligible impacts on dissolved oxygen are predicted.</p> <p>Dissolved inorganic nitrogen: Decrease in DIN not expected to have a significant impact on diatoms.</p>		

6. CURRENT KNOWLEDGE GAPS AND FUTURE INVESTIGATIONS AT GATE 3

6.1 PREVIOUSLY IDENTIFIED GAPS IN AQUATIC ECOLOGY UNDERSTANDING

At Gate 1 the aquatic ecology assessment identified evidence gaps which required addressing for Gate 2. Lists of these gaps for each assessment in Gate 1 were:

Aquatic invertebrates:

1. Additional monitoring was required to provide a robust dataset (Table 6-1) against which the potential effects of the schemes could be fully assessed. A minimum of three years of monitoring, encompassing two seasonal periods, ideally spring and autumn, in each year would provide a baseline in order to establish whether the invertebrate community responds to inter-annual changes in flow, water quality and temperature, and be comparable against current WFD standards.
2. It was noted that future assessment will need to consider changes in community composition to understand if there are any signification of correlations with inter annual variation in mean river temperatures, with a specific focus on those invertebrate taxa which are considered to be emergent species.
3. Additional information is required for temperature data regarding the extent of the mixing zone of the discharge from a Mogden STW Reuse outfall. Therefore, thermal plume modelling would be required to provide a greater understanding of thermal dispersion of the discharged water.

Table 6-1 Locations of Gate 1 evidence gaps for aquatic invertebrates

Reach	Site ID	Site	Location (NGR)
Reach A	LRUS - 001/EA Site ID197071	Desborough Cut	TQ0848566040
Upper section of Reach B		Site located U/S of Sunbury Weir (and a Mogden water recycling scheme outfall)	-
Reach B	LRUS - 003/EA Site ID184233	Downstream of Sunbury Lock	TQ1141168761
Upper section of Reach C		Upstream River Mole confluence	-
Reach C	LRUS - 005/EA Site ID35900	Downstream of Surbiton intake	TQ1744067824
Reach C	LRUS - 006/EA Site ID188056	Upstream of Teddington Weir	TQ1741471171
Reach G	LRUS - 016	Enfield Island	TQ3728398177

The Thames Water pan-SRO monitoring programme was set-up to achieve these requirements and provided 2020/2021 data for the Gate 2 assessments, with monitoring to continue into further years where necessary. The additional monitoring described above (1) and collected for the Gate 2 assessments has allowed this gap in evidence collection and assessment have been filled as part of the Gate 2 assessment.

Additionally, the thermal plume associated with dispersion of the Mogden water recycling outfall and Teddington DRA outfall (3) has been modelled⁶¹ and incorporated in the above assessments for Reaches A,B and C.

However, the community composition knowledge gap described above (2) requires further data to be able to achieve this requirement.

⁶¹ Ricardo (2022) London Effluent Strategic Resource Option, Gate 2 Water Quality Assessment Report.

Macrophytes:

1. Additional monitoring was required to provide a robust dataset (Table 6-2) against which the potential effects of the schemes could be fully assessed. A minimum of three years of monitoring would provide a baseline in order to establish whether the macrophyte community responds to annual changes and be comparable against current WFD standards.
2. It was noted that future assessments should also consider changes in community composition to understand if there are any significance correlations with inter annual variation in mean river temperatures.

Table 6-2 Locations of Gate 1 evidence gaps for macrophytes

Reach	Site	Location (NGR)
Reach A	Desborough Cut	TQ0848566040
Reach A	Downstream of Shepperton Lock	TQ0781765991
Upper section of Reach B	Site located U/S of Sunbury Weir (and a Mogden water recycling scheme outfall)	-
Reach B	Downstream of Sunbury Lock	TQ1141168761
Upper section of Reach C	Upstream River Mole confluence	-
Reach C	Downstream of Surbiton intake	TQ1744067824
Reach C	Upstream of Teddington Weir	TQ1741471171
Reach G	Enfield Island	TQ3728398177

The Thames Water pan-SRO monitoring programme was set-up to achieve these requirements and provided 2020/2021 data for the Gate 2 assessments, with monitoring to continue into further years where necessary. The additional monitoring described above (1) and collected for the Gate 2 assessments has allowed this gap in evidence collection and assessment have been filled as part of the Gate 2 assessment.

However, the community composition knowledge gap described above (2) requires further data to be able to achieve this requirement.

Diatoms:

1. Additional monitoring was required to provide a robust dataset (Table 6-3) against which the potential effects of the schemes could be fully assessed. A minimum of three years of monitoring, encompassing two seasonal periods, ideally spring and autumn, in each year would provide a baseline in order to establish whether the diatom community responds to inter-annual changes and be comparable against current WFD standards.

Table 6-3 Locations of Gate 1 evidence gaps for diatoms

Reach	Site	Location (NGR)
Reach A	Desborough Cut	TQ0848566040
Reach A	Downstream of Shepperton Lock	TQ0781765991
Upper section of Reach B	Site located U/S of Sunbury Weir (and a Mogden water recycling scheme outfall)	-
Reach B	Downstream of Sunbury Lock	TQ1141168761
Upper section of Reach C	Upstream River Mole confluence	-
Reach C	Downstream of Surbiton intake	TQ1744067824
Reach C	Upstream of Teddington Weir	TQ1741471171
Reach G	Enfield Island	TQ3728398177

The Thames Water pan-SRO monitoring programme was set-up to achieve these requirements and provided 2020/2021 data for the Gate 2 assessments, with monitoring to continue into further years where necessary. The additional monitoring described above (1) and collected for the Gate 2 assessments has allowed this gap in evidence collection and assessment have been filled as part of the Gate 2 assessment.

Designated and protected sites and species:

1. For the designated site of Ham Lands LNR, the extent, location, and condition of marginal and wetland habitats that are dependent on water level within the River Thames for maintenance of current/achievement of favourable condition.
2. For the designated site of Isleworth Ait LNR, the extent, location, and condition of marginal and wetland habitats that are dependent on water level within the River Thames for maintenance of current/achievement of favourable condition.
3. For the designated site of Syon Park SSSI, the extent, location, and condition of marginal and wetland habitats that are dependent on water level within the River Thames for maintenance of current/achievement of favourable condition.

These gaps in evidence collection and assessment have been filled as part of the Gate 2 assessment.

6.2 KNOWLEDGE GAPS IDENTIFIED DURING GATE 2

The comprehensive aquatic ecology assessment at Gate 2 for the London Effluent Reuse schemes has identified the magnitude of aquatic ecology effects in both the freshwater and estuarine study areas of the schemes. However, Gate 2 knowledge gaps have also been identified and are described below:

Aquatic invertebrates:

1. Additional monitoring is required to provide a robust dataset (Table 6-4) against which the potential effects of the schemes can be fully assessed. A minimum of three years of monitoring, encompassing two seasonal periods, ideally spring and autumn, in each year would provide a baseline in order to establish whether the invertebrate community responds to inter-annual changes in flow, water quality and temperature, and be comparable against current WFD TraC standards.
2. It is noted that future assessment will need to consider changes in community composition to understand if there are any signification of correlations with inter annual variation in mean temperatures, with a specific focus on those invertebrate taxa which are considered to be emergent species.

Table 6-4 Locations of Gate 2 evidence gaps for aquatic invertebrates

Reach	Site	Location (NGR)
Reach E	Battersea Park to Tower Bridge	TBC
Reach F	Tower Bridge to 3km seawards of Beckton STW	TBC
Reach I	Three Mills Lock to Thames Tideway	TBC

Phytoplankton:

1. Additional monitoring is required to provide a robust dataset (Table 6-5) against which the potential effects of the schemes can be fully assessed. A minimum of three years of monitoring, encompassing two seasonal periods, ideally spring and autumn, in each year would provide a baseline in order to establish whether the diatom community responds to inter-annual changes and be comparable against current WFD standards.

Table 6-5 Locations of Gate 2 evidence gaps for phytoplankton

Reach	Site	Location (NGR)
Reach E	Battersea Park to Tower Bridge	TBC
Reach F	Tower Bridge to 3km seawards of Beckton STW	TBC
Reach I	Three Mills Lock to Thames Tideway	TBC

Macroalgae, Angiosperm and Phytoplankton:

Macroalgae surveys are proposed within Reach E and Reach F during August 2022. As such, the results of these surveys will indicate any knowledge gaps within the scheme area and any proposed monitoring within Gate 3.

Marine angiosperms are not present within the upper and middle Thames Tideway and angiosperm beds are circa 45km down river of Beckton STW. As such, there are no proposals to undertake angiosperm surveys within Gate 3.

Designated and protected sites and species:

No knowledge gaps have been identified at Gate 2.

6.3 FUTURE INVESTIGATIONS AT GATE 3

Further specificity can be added to the aquatic ecology investigations at Gate 3 through additional data and evidence gathering in Reaches E and F for:

- Invertebrates, and
- Phytoplankton.



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